ELECTRICAL REVIEW

[ILLUSTRATED]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

Vol. 4, No. 21. WEEKLY. | NEW YORK, SATURDAY, JULY 26, 1884. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1883, by DELANO & COMPANY, 23 Park Row, New York.

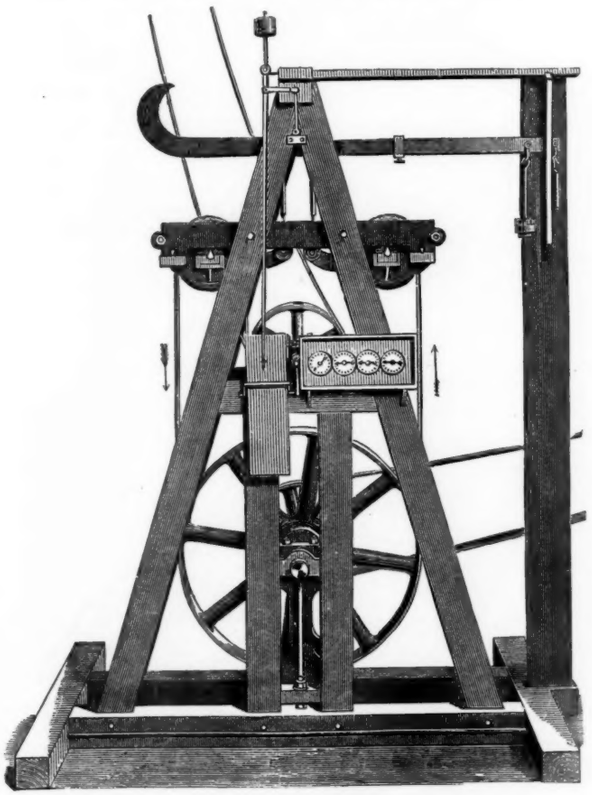
Entered at Post Office, New York, as Mail Matter of the Second Class.

Tatham's Dynamometer.

The form of Tatham dynamometer, which we illustrate to-day, has been constructed, we are informed, for the use of the Franklin Institute. It consists of double wooden A frames, braced together and carrying four pulleys between them. Of these, the lower is driven from the engine or prime mover, and transmits motion to the one immediately above it, which is connected, by an elongation of its shaft, not shown in the view, to the machine whose consumption of power is to be determined. The remaining two pulleys are idle, and are carried in separate lever frames. Each frame is suspended, at its outer end, upon knife edges carried upon a crossbar, and is connected at its inner end by a link to a scale end above it. These two links are attached to the scale beam on opposite sides of the pivot (1.9 in. therefrom), and consequently their action upon it may be balanced by a weight that corresponds to their difference. The beam is capable of weighing up to 300 lbs., and is graduated to 25 lbs., by pounds and tenths; it may be balanced by dead weights, or by a spring balance, the latter being used when an indicator diagram is being produced. From the center of the beam to the extreme right hand is 32¼ in., from which it may be deduced that the scale of the illustration is about $\frac{1}{13}$th.

The idle pulleys are each 7 in. broad, and the largest and smallest circumference of each is 27$\frac{5}{16}$ in. and 27 in., whence it follows that the average radius is 4.30375 in. The axis of each pulley is situated 4.39 in. from a line joining the knife edges on which its lever frame turns, the effective radius of the pulley having been found to be 4.387256 in. The distance of the axis from the suspension link is 8.78 in. The middle pulley, which drives the counter and indicator card, is 7 in. broad, and has a maximum circumference of 38¾ in., and a minimum circumference of 38$\frac{7}{16}$ in., or 38.59375 in., on the average. Careful measurements show that the delivery of belt per revolution is 39.595 in. The driving pulley is 30 in. diameter and 7 in. broad, and runs in journals that can be adjusted vertically to tighten the belt. The latter is 16 ft. long, 6 in. wide, and ⅛ in. thick, of oak-tanned leather. The splices are scarfed, glued and riveted, so as to preserve a uniform thickness. The flesh side of the belt is next the driving pulley and the two idle pulleys, and the hair side is next the upper middle pulley. The belt runs in the direction of the arrows on the outside, down on the left and up on the right. But in describing its operation it is better to follow the tension of the belt in a direction contrary to the motion of the belt itself. The tension, originating at the lower driving wheel, acts vertically upon the left-hand idle pulley at the extremity of its effective radius, and cuts a line joining the two knife edges, which constitute the fulcrum of the lever frame. The effect of this part of the belt upon the scale beam is, therefore, *nil*.

Losing enough force to overcome the friction of the idle pulley, the remaining tension acts vertically, first by reaction upon the lever frame carrying the idle pulley at a point corresponding to the extremity of the inside effective radius of the pulley, and thence through the link upon the positive side of the scale beam; and, second, upon the middle pulley representing the machine on trial. These forces are equal and opposite. The tension, acting on the middle pulley, then performs the work that is to be measured and is reduced thereby. The remainder acts, first, by reaction on the middle pulley; and, second, directly upon the lever frame carrying the right-hand idle pulley, and thence through the link to the negative side of the scale beam. These two forces are also equal and opposite. The tension then passes over the



THE TATHAM DYNAMOMETER.

idle pulley, through the fulcrum, as before, to the place of beginning. It is evident, therefore, that the only forces bearing upon the scale beam are the tension of the tight belt on the positive side of the beam, and the tension of the slack belt on the negative side. The beam weighs the difference between the two; and if its indication in pounds be multiplied by the number of revolutions of the middle pulley per minute, and the product be divided by 10,000, the result will be horse-power and decimals.

The principal center of the scale beam is lengthened towards the observer, and at its nearest extremity carries a lever arm attached to a horizontal link, connecting it with a long vertical index lever, which carries a pencil at its lower end. This pencil moves horizontally as the end of the lever vibrates vertically, and marks upon a ribbon of paper, caused to move vertically between two revolving rollers, which are driven by the worm upon the prolongation of the shaft of the middle pulley. If the scale beam be attached to the spring balance, the ordinates of the curve traced by the pencil will represent the force employed, while the abscissæ will represent the motion. We are indebted for the account of this machine to the Franklin Institute.

Health and the Electric Light.

The good or evil influence of the artificial light we use, upon the health, is of the very highest importance, although, hitherto, it has been to a great extent overlooked. Ancient custom has so familiarized us with combustion as a source of light that, until recent years, we hardly ever dreamed there could be any other. Nevertheless, the introduction of the electric light has been opening our minds of late to the advantages of a purer kind of illumination, and our object will be in the present article to illustrate some of these to the reader.

All the older illuminators depend directly upon combustion. They yield a light because the oxygen of the air is burned; and the quantity and brilliance of the light they give are higher, as the oxygen consumed is greater. In other words, the light is obtained at the expense of the air we breathe; and the richer the light the poorer becomes the air. But it is on the oxygen of the air that we ourselves depend; and if we burn it in our lamps we may destroy it for our breathing. It is estimated that a single gas jet in a room consumes as much oxygen as five or six individuals; hence, the air in a room lighted by two gas jets is as bad and unwholesome as if there were a dozen people sitting in it. Yet many persons who would shrink from joining such a party would have no hesitation with keeping company with the gas jets. The chief difference is that in the one case our instinct brings the evil home to us; and in the other case it does not. The gas jets are permitted to instil their poisons unsuspected, and to give rise to a thousand forms of ill-health and discomfort which are never traced to the real offender.

Pure air is what we all seek when we go to the seaside or the mountain-top during our holidays. How important then is it that we should have pure air in our homes. The necessity which obliges us to live in towns also obliges us to live in a more or less vitiated atmosphere. The mere fact of so many living beings crowded together is of itself sufficient to deteriorate the air. Assuredly it is not desirable that the very light we use should also vitiate the atmosphere. Pure air and light are essential to good health, but in close ill-ventilated city offices, and in thousands of homes and workshops, what prospect is there of a pure air while the lights which are burned often half the day are of themselves polluting it? For not only does a candle, oil or gas flame waste the oxygen of the air, and thus rob it of its life-supporting virtue, but it actually soils it with noxious vapors, the products of combustion. These are chiefly water or steam, and carbonic acid; but carbon dust or soot is also thrown off, and in the case of gas, sulphuric acid.

To explain this more particularly we will take the case of a common gas jet. The chemical composition of average lighting gas is, according to Roscoe:

Hydrogen	47.60	volumes in 100 of the gas,	
Marsh gas	41.53	"	"
Heavy hydrocarbon equal to olefiant gas 6.97	3.05	"	"
Carbonic oxide	7.82	"	"
	100.00		

When, therefore, an ordinary gas jet is turned on, this poisonous mixture is let into the room at the rate of five cubic feet per hour. The application of a lighted match supplies the needed temperature to cause the chemical combination of the hydrogen in the gas with the oxygen in the air. In every five cubic feet of air in the room there is a cubic foot of oxygen and four of nitrogen. This oxygen, which otherwise would support animal life, is united with the hydrogen of the coal gas to form water (H_2O), and with the carbon to form *carbonic acid gas*, or carbon dioxide (CO_2). Moreover, although not stated in the analysis we have given above, it is well known that most kinds of illuminating gas contain sulphuretted hydrogen and carbon disulphide. These gases are also inflammable, and the sulphur in them is given off by the flame in the form of sulphuric acid or, as it is commonly called, "vitriol."

The following table, from Dr. Tidy's

"Handbook of Modern Chemistry," will give some idea of the scale on which these chemical changes are taking place with gas, oil and candles:

Burnt to give a Light equal to 12 Sperm Candles (Burning 120 Grains per Hour).	Heat Produced Reckoned in Pounds of Water Raised 10° Fahr.	Cubic feet of Air Vitiated per hour.	Cubic Feet of Carbonic Acid Produced per hour.	Cubic Feet of Air Consumed per hour	Cubic Feet of Oxygen Consumed per hour
Cannel coal gas	195.0	217.50	2.01	16.50	3.30
Common gas	278.6	348.25	3.21	17.25	5.45
Sperm oil	293.5	356.75	3.33	23.75	4.75
Benzole oil	232.6	376.30	3.54	22.30	4.46
Paraffin oil	361.9	484.05	4.50	34.05	6.81
Camphine	325.1	510.25	4.77	33.25	6.65
Sperm candles	351.7	614.85	5.77	37.85	7.57
Wax "	383.1	632.25	5.90	42.05	8.41
Stearine "	374.7	669.10	6.25	44.10	8.82
Tallow "	505.4	933.00	8.73	60.00	12.00

The unit in which the quantity of heat generated is set down, is the amount of heat required to raise a pound of water by a temperature of 10° on Fahrenheit's thermometer.

This is a very instructive Table, and some of the figures, compared with more recent experiments by Mr. Ferd, a German chemist, agree very well. Thus Mr. Ferd finds that 100 sperm candles burning for an hour give off 41.30 cubic feet of carbonic acid; while the same figure, according to Dr. Tidy's results, would be 47.89 cubic feet. Sperm candles, besides being the best to use in a household, are generally pure, and hence the agreement in the results by independent experimenters employing different methods.

If we accept Dr. Tidy's Table as correct, and it is probably not very far wrong, we find that cannel coal gas, such as is burned in Glasgow, is the best to use. Common gas is, however, that which we ought to consider, since it is most generally employed. The ordinary gas-burner yields a light of some twelve candles for the consumption of five cubic feet of gas per hour, though better burners give more, say fifteen candles. It follows from the Table that every gas burner in a room consumes 5.45 cubic feet of oxygen per hour, that is to say, it completely deprives 17.25 cubic feet of air of its oxygen in an hour. A sitting-room, sixteen feet long by ten feet wide and nine feet high, contains 1440 cubic feet of air, and one gas burner would abstract all the oxygen from this room in eighty hours. In eight hours it would abstract one-tenth of the oxygen, provided always there were no fresh air entering. We see then how important it is that a room, in which gas is burning, should be well ventilated. Air without oxygen is, of course, unbreathable and cannot support life. Nitrogen is an inert substance, and extinguishes both flame and life, because oxygen is absent. In the air it is employed to dilute the oxygen and temper the action of the latter on combustion, and on the blood when taken into the lungs.

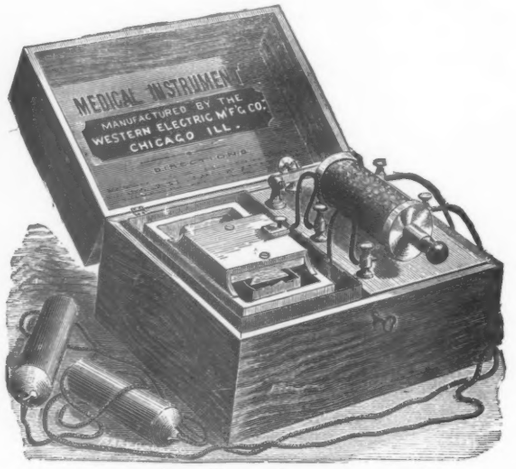
But gas and other lights produced by combustion not only rob the air of its health-giving oxygen, they adulterate what remains of it. Carbonic acid gas, which is supplied to the atmosphere from a flame, is an active poison fatal to animal life. It is the "choke damp" of the miner; and though always present in minute quantities in the atmosphere, it becomes dangerous when in excess. In the air expelled from the lungs there is four per cent. of it; and air containing this quantity is quite unbreathable. The following data from Professor Huxley's "Physiography" show the percentage of carbonic acid in air taken from different places:

	Percentage.
On the Thames at London, mean	.0343
In the streets of London	.0380
From the top of Ben Nevis	.0327
From the Queen's Ward, St. Thomas' Hospital	.0400
From the Haymarket Theatre, dress circle at 11.30 P.M.	.0757
From Chancery-court, seven feet from the ground	.1930
From Underground Railway, mean	.1452
From workings in mines, average of 339 samples	.7852
Largest amount in a Cornish mine	2.5000

Dr. Tidy gives the normal quantity of carbonic acid in the atmosphere as .04 per cent., and the above results for the open air would seem to show that his estimate is not too low. He likewise considers that one per cent. of carbonic acid in the air is distressing, an estimate which experience in Chancery Courts, or on the Underground Railway amply confirm. Indeed, to make a journey by this line is simply to submit oneself to a slow poisoning for a certain time; and the lives of the railway servants tending the trains all day upon it must be materially shortened, just as the lives of miners are shortened by working underground. Air containing two per cent. is decidedly dangerous; and (if Dr. Tidy is correct) even .1 per cent., or something more than is found in a crowded theatre after the play, may be regarded as a notable pollution. But we gather from Dr. Tidy's Table that at the end of an hour, 3.21 cubic feet of carbonic acid have been delivered to the air of a room from each gas jet; and this in a room sixteen feet by ten feet by nine feet, such as we have considered, and containing 1440 cubic feet of air, amounts to .22 per cent. At the end of half an hour the distressing limit (.1 per cent.) would be reached, were there no ventilation to bring in fresh air and carry off the vitiated. At the end of something less than twenty hours the four per cent. irrepressible limit would be reached.

Combining, then, the double action of the gas jet in consuming the oxygen from the air and polluting it with carbonic acid, we gather some idea of the vitiating process which goes on and of its extent. Ventilation only can save the air of an ordinary room from becoming unfit for breathing purposes in the course of a few hours, if there is even a single gas jet in it; and ventilation is in many cases quite defective.

PHYSICIANS' DOUBLE-CELL BATTERY.



BLISS FAMILY BATTERY.

Nor have we considered all the evils that arise from gas, oil or candle lights. The carbon which when heated up to whiteness makes the light, is never entirely oxidized. A great proportion of it, especially with inferior candles, lamps and gas-burners, is given off in the form of smoke or soot, and this of itself pollutes the air and settles on the furniture. It is found by experiment that the ordinary gas jet only yields one-third of the light which the gas is capable of giving when consumed in a good burner. It follows that combustion is rarely complete in gas burners; and that the gas itself, in a more or less altered state, is delivered to the atmosphere along with the carbonic acid which we have considered. Water vapor is also given off abundantly, and though innocuous to breathe, it does not add to the comfort or cleanliness of a room. "Any one," says Dr. F. W. Griffin, of Bristol, "any one who has never tried the experiment would be astonished were he to mount a pair of steps and feel what the air is like near the ceiling of a sitting-room in which gas has been burning for some time. This alone would injure wall-papers and hangings, as well as goods on the upper shelves of shops; but the large amount of water generated by the gas-flame adds to the mischief. Sixty burners will produce on the lowest computation two gallons of water per hour; hence in a November evening many large shops filled with delicate goods will have a nine-gallon caskful of water thrown into their atmosphere in the form of steam, to condense on any cool surface, as we often see it trickling down the windows in winter. But worse remains behind. The sulphur always present in gas, in larger or smaller proportions, according to the character of the coal employed, burns into sulphurous vapor, which passes in the air to the state of oil of vitriol.

"The eminent chemist, Dr. Prout, exposed water in a drawing-room in which gas was burnt, and found that it absorbed sufficient of these vitriolic emanations to redden blue litmus, and show the presence of free sulphuric acid. The fumes from gas will, indeed, in the long run, discolor every sort of fabric, rust metals, rot gutta-percha and reduce leather (as in the binding of books) to a scarcely coherent powder with a strongly acid taste. The late Dr. Letheby, in an able report on the coal gas supplied to the City of London, gives numerous instances of the destructive effects of these products of gas lighting. Enormous damage has been done to the binding of the books in the libraries of the Athenæum Club, the London Institution and the Royal College of Surgeons. In the first-named, wherever the books had been exposed to the atmosphere containing the vapors of burnt gas, they were as rotten as tinder; indeed, it often happened that the covers gave way in attempting to remove a book from its place on the shelf. * * * The Librarian of the Newcastle Literary and Philosophical Society wrote that a book which had been missing for thirty-six years was sound and good when recovered, while the leather on the books in the same binding which had remained in the library had been utterly destroyed. He further wrote that the ventilators having been fitted over the chandeliers of the library, half a gallon of water is collected a night from the gas that is burned there; this water is so corrosive from the presence of sulphuric acid that it attacks all kinds of metal fittings with which it comes into contact, and thereby acquires a metallic impregnation of copper and iron. Drapers know to their cost how the edges of pieces of dyed fabrics become faded and rotten when kept long on the upper shelves of gas-lighted shops; no plant will grow in a room where gas is burning, and cut flowers quickly wither; while those who work long and habitually in close gas-lighted rooms become blanched and sickly."

It is for the above reason, as well as for its freedom from fire risks, that the electric light has been introduced into the library of the British Museum. The large "arc" light is employed there, but the smaller incandescent light is still better adapted for interiors. This is a light which consumes no oxygen, gives off no carbonic acid or water vapor or sulphuric acid whatever, and only a fraction of the heat which is given off by gas, oil or candles. We estimate from the experiments of M. Ferd and others, that an incandescent electric lamp such as that of Swan or Edison, only gives from one-fifth to one-tenth the heating effect of an ordinary gas jet. It is sometimes cited against the electric light that it does not give off more heat, but broadly considered this is a merit rather than a fault. Fires and heated pipes are the proper contrivances to give us artificial warmth, not lamps which serve the different purpose of yielding *light*. It is precisely because the electric light gives us light and nothing more that its purity is so highly to be recommended. Professor Pickering, of Harvard University, recently made an investigation into the cause of weak sight amongst the students, and traced it to the heat given

off by their reading lamps, which dried up the humors of the eye. For the very reason, then, that it gives a cooler light, the incandescent lamp is preferable to gas, oil or candle light.

Produced by a current of electricity in a carbon filament within a vacuum bulb of glass, and excluded from the atmospheric air, the incandescent light is absolutely healthy. It yields a pure and almost ideal light, that is to say, a light and nothing more. In this it resembles the sunshine, which neither consumes nor pollutes the air. It is almost as beautiful as sunlight, too, and this is a merit which also tells on the side of health; moreover, it lends itself to artistic treatment in the most admirable way.

At last, by the progress of science, we have obtained an artificial light which is nearly all that could be wished. The primitive torch and candle, in which a solid was consumed, the oil lamp which burned a liquid, the flaming jet of gas, have given place in turn to the more ethereal source supplied by electricity, and each advance, as we may see from Dr. Tidy's Table, has been in the direction of greater purity with the finer medium employed. The last step reaches to absolute purity, and is unquestionably the light of the future, if for no other reason than this. On the score of health alone, as we have endeavored to show, its introduction ought to be hastened as much as possible, nor should it be only the luxury of the rich, as a famous electrician, recently deceased, proclaimed it, but the necessity of the poor. Where purity and brightness are most needed, there purity and brightness should first come.—*Engineering.*

Faradaic and Galvanic Batteries for Medical Purposes.

A recent article in this journal on the above subject elicited several inquiries from our readers in reference to the employment of electro-medical apparatus. We are enabled to answer them to-day by illustrating several of the best forms of medical batteries now in use. Those shown in the accompanying cuts are manufactured in this city by the Western Electric Company, makers of surgical and electro-medical apparatus. It would seem that whatever form, of electricity we may make use of, we have to do, of course, with one and the same force, represented by the voltaic, induced, static and other phases. True as this may be in a general sense, in medical electricity as in the laboratory and in the arts, it would be ridiculous to expect equivalent results from an indiscriminate employment of any one of these various forms. Wide differences in indications for use and curative results exist, both in the nature of the electricity used and in the manner of its use.

It has been shown that currents of different qualities have not only different characters of sensation, and different effects on muscular irritability, as recognized by all who have carefully scrutinized in regard to these varied electrical phenomena, but also one quality even when so weak in power as not to produce any pain, but rather a pleasant sensation, will show flashes of light when properly applied, as with large surface of wet sponge over the closed eye.

The various styles of Faradaic batteries manufactured are designed to meet a want long felt in the medical profession, *i. e.*, a battery well made, elegant in finish, easy to handle and understand, durable, not liable to get out of order, easily repaired if out of order, with wide scope of current, a proper amount of quantity and electro-motive force and a soft, not unpleasant, current.

These batteries are so constructed as to make sure connection, without any disagreeable stopping or *jerking*. In the hydrostat batteries there is no necessity for lifting the dripping plates out of the solution and removing them from the jar, thus endangering the metallic parts of the instrument.

The physician's battery and hydrostat family battery are made with two styles of hydrostats, called the "Monitor" and the "Groove." The "Monitor" has a cylindrical drum, in which a spiral spring is worked by crank; as the crank is turned the zinc plate is raised or lowered. In the "Groove" the zinc is attached to a spiral spring, playing in an arched groove, and worked by a thumb-screw.

A great advantage of this form of hydrostat is, that the strength of the current can be regulated by the depth to which the plate is immersed in the solution.

The family and also the physician's battery illustrated herewith are constructed as follows:

The case is black walnut.

The helix is composed of the best silk-covered copper wire.

The metallic parts are nickel-plated.

There is always a convenient arrangement for raising and lowering the battery plates where needed.

In the Faradaic instruments either the primary or secondary current may be used at pleasure. The armature is of fine German silver, with a soft iron head. A screw graduates the vibrations. The helix is inclosed in a highly finished hard-rubber case; and a regulator is attached, which increases the strength of the current as it is withdrawn from the coil.

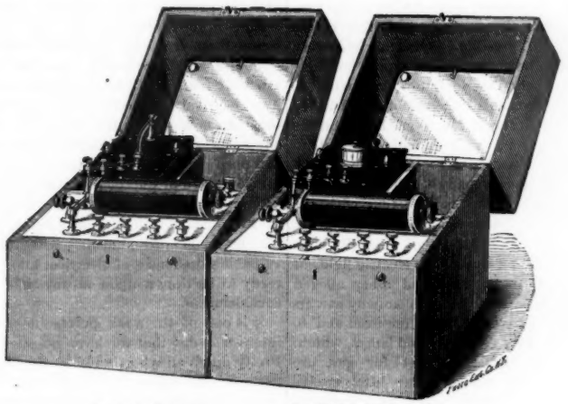
The bichromate of potash solution, or "electropoion fluid," is used in the battery; it may be made as follows:—To eight pints of water add two pints sulphuric acid; while the mixture is still hot, stir in one pound bichromate of potash. It is ready for use when cold.

The chloride of silver battery is a convenient form of portable battery for supplying the uninterrupted galvanic current, and is used principally by physicians. It affords greater power for the same compass than any other known, and it must become a great favorite, on account of its compactness, cleanliness and simplicity.

The cell is very small, being an inch in diameter by five and one-half deep. It contains a strip of zinc and a strip of silver, the latter being covered with about 8 dwt. of fused chloride of silver. The solution is water and sal ammoniac, in the proportion of a pint of the former to 8½ dwt. of the latter.

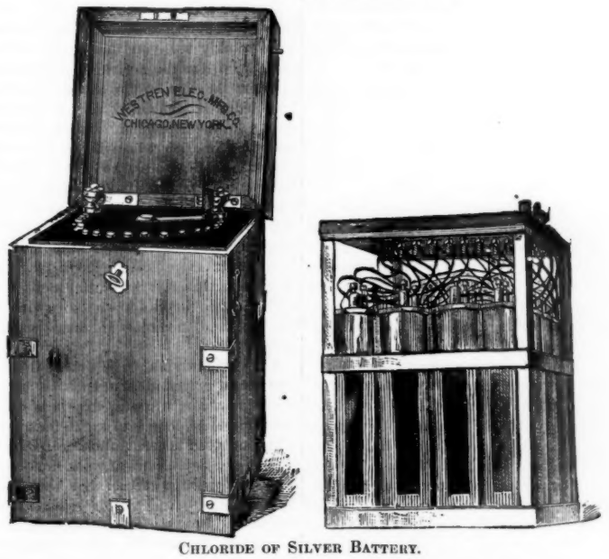
The action of the battery is due to the reduction of the chloride to metallic silver when in contact with zinc, and there is absolutely no action except when the poles are connected; neither is there any appreciable polarization when on closed circuit, as is usually the case with open circuit batteries. After being on short circuit for two hours the loss of electro-motive force is less than five per cent.

The electro-motive force of each cell is 1.12 volts, and the internal resistance about 2 ohms. It is, therefore, about one-tenth more powerful cell for cell, than Daniell battery, and the internal resistance is much less.



GROOVE MONITOR

FAMILY BATTERY, HYDROSTAT.



CHLORIDE OF SILVER BATTERY.

Selenium and Its Uses.

Selenium is an elementary substance that is found in nature associated with deposits of sulphur. It was discovered in 1817 by Berzelius. This somewhat rare element crystallizes in four-sided prisms, and is about four times as heavy as water. It is as brittle as glass, but, unlike the latter substance, is readily cut or scratched. Selenium, when suddenly cooled from a fused state, possesses a reddish-brown, metallic luster with a conchoidal fracture, which, by exposure to the air, assumes a dull, leaden-gray color. The name, selenium, is derived from the Greek word, *σελήνη*, the moon. When rapidly cooled from a state of fusion, selenium is a non-conductor of electricity, but when cooled very slowly it is a conductor. In this latter condition it possesses a granular appearance, and a metallic luster.

It was during the experiments of Willoughby Smith that an exceedingly valuable property of selenium was discovered. While making some experiments in his system of cable testing, he was considerably puzzled by the extreme variability in the results he obtained. Persistent efforts in tracing the cause of these discrepancies resulted in the extremely valuable discovery that the electrical resistance of selenium was less while exposed to the sunlight, than when in the dark. This valuable discovery was made in May, 1872, and was communicated to the Society of Telegraph Engineers on the 17th of February, 1873. His apparatus consisted of platinum wires, inserted into the opposite ends of a bar of selenium, hermetically sealed in a glass tube. This was placed in a dark box and suitably connected with instruments by means of which its electrical resistance could be measured. When so arranged, the exposure to the light, consequent on opening the lid of the box, caused an instantaneous reduction in the resistance. So sensitive was this arrangement to the action of light that merely placing the hand between the selenium bar and the light of a distant gas burner, instantly affected the instrument.

The discovery of this curious property of selenium naturally attracted considerable attention from scientific men in different parts of the world, and numerous investigations were made concerning its properties. For example: Professor Adams, of Kings College, showed that the greenish-yellow rays were the most effective in varying the resistance of selenium, and Professor Siemens produced a variety of selenium that was fifteen times as great a conductor of electricity in the light as in the dark.

Among some of the more interesting applications of the variations in the electrical resistance of selenium, by the action of light we may mention the "selenium eye," in which an attempt was made to imitate the action of light on the iris of the human eye. By an ingenious use of selenium resistances, introduced into the circuit of a battery, the inventor caused the intensity of the light that entered a lens to be maintained approximately constant by the action of an electro-magnet that varied the size of the opening of a diaphragm, in this manner roughly imitating the contraction and dilatation of the pupil of the eye.

Perhaps one of the most famous uses of this property of selenium was made by Alex. Graham Bell, of telephone celebrity. This inventor, in an instrument he called a telephote, has so utilized the variations in the electrical resistance of selenium while under the influence of light, as to be able actually to hold telephonic communication along a ray of light, instead of along the customary metallic wire. The telephone is now generally known under the general name of radiophone.

Numerous attempts have been made, in different parts of the world, to utilize this variation in the electrical resistance of selenium under the influence of light for the transmission of photographs or outline sketches by electricity. Some of these attempts have been comparatively successful, and we may in a subsequent issue discuss them in detail.

We shall not be found wanting in the Exhibition in a display of this curious element. A single exhibitor has applied for space for an exhibit of selenium resistances that he values at $10,000. An application has also been made by a French savant who contemplates exhibiting an instrument called the telectroscope, designed to transmit photographic images by means of electricity by the use of selenium resistances —*The Bulletin, Philadelphia.*

The directors of the Erie Telephone Company met on Saturday to consider the dividend question, but deferred final action until August 11, when the returns from all of the divisions for the quarter will have been received. Heretofore it has been customary to estimate the earnings for a month or so, but that course is not considered wise on this occasion. The situation is understood to be this: Five directors favor paying some dividend—say, 50 cents per share—and three are opposed to paying anything until, as set forth in this column a few days ago, the floating debt of $200,000 is reduced or paid. It looks now like a quarterly dividend of 50 cents or none at all. The net increase of subscribers in April and May was 406.

Electrical Review.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, }
WM. A. HOVEY, } - - - Editors.
THOMAS H. DELANO, - - - - Publisher.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, JULY 26, 1884.

CONTENTS.

	PAGE
Tatham's Dynamometer	1
Health and the Electric Light	1
Faradaic and Galvanic Batteries for Medical Purposes	3
Editorial Notes	4
Concerning Experts	4
The Electrical Exhibition	4
Mariner's Compass	5
Driven by an Electric Motor	5
A New Surgical Lamp	5
Telephonic News	6
The Atlanta Telephone Exchange	6
National Telephone Exchange Association	6
On Underground Wires	6
A Pooling Agreement	6
Unequaled Conditions for Deserving Public Confidence	7
Telegraphic Notes	7
Electrical and Scientific	8
Electric Lights on the Common	8
The Electrical Exhibition, illustrated	8
Electric Light News	9
New Electrical Patents	10

The hope is heard expressed on every hand that the Greeley expedition, which resulted in the loss of nineteen lives by starvation and exposure, will be the last sent into the frozen North. We venture the prediction that there will be many more, and that it will be claimed that *now* the secret of success in Arctic exploration has been discovered, viz: to have depots on land, at reasonable distances apart, well supplied with food and fuel; the one farthest South to be within easy reach of the civilized world, and the one farthest North to be as near the pole as the explorers can get. It is already pointed out, in fact, that with an assured line of retreat in the event of disaster, men would push further and further every year, each advanced post becoming in its turn a link in the chain of communication, and that now, more than ever before, the attainment of the pole itself seems probable. And we further venture the prediction that the public will be enthusiastic for just such an enterprise, notwithstanding its present temper.

As we predicted last week, the several companies constituting the opposition to the Western Union have come together under a pooling arrangement, and will all be worked under one management. This makes a pill so large that it is hardly probable that Gould will even try to swallow it, and fair, straightforward competition between the two combinations is therefore to be looked for.

We learn that the managers of the electrical exhibition in Philadelphia, after consulting their electricians, have refused, on the ground of danger from fire, to have any conductors of electricity put under ground. The underground systems are to be exhibited, but they are to be on tables as exhibits, and are not allowed to be operated beneath the surface. It is the belief of the electricians that a buried conductor, coming to the surface in the basement of buildings, and the connection made there, is far more dangerous than an overhead wire, and hence the decision that has been made. This will rather startle some of the able editors who, in the intervals of political writing, throw off mandatory editorials to the effect that immunity from electric danger is only to be had by putting all wires underground. Meantime, let us remember that of all the damage which has resulted from the use of electric wires in this great city of New York, where the wiring has, in many instances, been done in the most slovenly manner possible, three-fourths has been caused by underground wires.

Our esteemed contemporary, the Boston *Evening Transcript*, after taking every possible opportunity to sneer and fling at the electric light, greedily copying any and every statement, however absurd upon its face, and being very slow to follow them with the truth, has come to the conclusion that the partial substitution of large gas lamps on the Common was an unwise move, and wants to know why it was done. Well, it was done because the gas company wanted it done, because the gas company is potent with the committee on lamps, and because the *Transcript* and other papers of that ilk have spoken in such a way of the electric light, of its dangers, its expense and other alleged disadvantages, that the gas company saw its way clear to have the lamps removed and to putting up their yellow-flamed lamps, which, in order to reduce the cost for gas, are reduced to one weak burner after twelve o'clock, the very time when, as a matter of public safety, a good light is most needed. All the facts and figures in the case were just as attainable by the *Transcript* before the change was made as now, but it preferred to wait until it was made before entering its protest. We remember a man who, having exhausted his adjectives of contempt, wound up by calling another a "consumptive cuss." The *Transcript*, some months since, apparently short of phrases which would express its disgust, indulged its wrath by speaking of the electric light as "political." Just what idea it intended to convey was not clear; but if there be, in Boston, any light that just now deserves to be called "political," it is gas-light, which is forced upon the people against the recorded wish of the city government by the committee on lamps, which is the willing tool of the Boston Gas-Light Company.

An important decision has just been rendered by Judge Shipman of the United States District Court for the Southern District of New York, in the suit of the Brush Company against the New England Weston Electric Light Company. The suit was brought, nominally, against Condit, Hanson and Van Winkle, agents of the Weston Company in New York, but was in reality against the United States Electric Lighting Company. There were two patents involved, one on metal-plated carbons and the other on the use of a clamp in an arc lamp. The Brush Company made a motion at the argument to withdraw the carbon patent. Judge Shipman decides that they may do this upon paying costs and giving the United States Electric Lighting Company a stipulation that they may use the same testimony in any future suit that is brought against them without talking it over again. This means, practically, that the Brush Company has abandoned the carbon patent.

In regard to the clamp patent, Judge Shipman decides that the patent is completely anticipated by a lamp which was made and used at Ansonia, Conn., in 1876, and he holds the patent to be invalid, and directs that the bill of complaint be dismissed, with costs.

The suit has been about four years in course of trial, and the testimony taken covers upward of 2,000 printed pages. The principal brief of the Brush counsel was 484 printed pages and the oral argument occupied eight days.

CONCERNING EXPERTS.

With the progress and growth of electrical research and discovery there have grown up a number of men, more or less deserving the title, who are called electrical experts, and to whom those in search of exact information on matters electrical or the solution of some electrical problem are forced to turn. They are graduates of the school of experience. What they know has been picked up by reading and by experiment, and the best of them, to-day, are men who never took an electrical course in any school or college, for the very simple reason that in their student days no such thing as an electrical course, really deserving the name, existed in any institution of learning. By a process of natural selection they have come to the surface, because of the aptitude they have shown in one branch or another of electrical research, and the proof of their capacity, instead of resting on the diploma of a college, is to be found in their work. The time will come, of course, and that shortly, when the various scientific schools will be sending out more or less electrical engineers every year, just as they are now graduating civil and mining engineers, young men fully and thoroughly equipped with an exact knowledge of all that is known of the science, ready to answer promptly any reasonable question in any part of the domain of electrical science. They may not be geniuses, but they will at least be valuable storehouses of electrical knowledge, ready to be drawn upon at any time—for a consideration.

It is one of the weak points in electrical interests to-day that we have no such men. Pretty much all who figure as electrical experts are in reality inventors, who, of necessity, have made the science a study, but always with the same distinct end in view, so that their knowledge, though highly useful and valuable, is restricted in its range, rather than broad and catholic. You will find those who frankly tell you that their study has been devoted to the electric light exclusively, and that they are, so far as exact electrical knowledge is concerned, very much in the dark as to the telephone. But such men are rare, for, for each who will be thus frank, you will find a dozen who, although exactly the same is true of them, boldly claim to know it all, and profess to have an opinion—and a valuable one—concerning departments of electrical science of which the knowledge is, to put it very mildly, exceedingly limited. As experts, therefore, they are even worse than useless, since they set up to know what they do not, and mislead by their pretended knowledge.

The obvious moral to be drawn from this somewhat extended statement is that, as things now are, when an expert is wanted, the thing to be done is to search for some one who has given special attention to the particular class of electrical work in hand, and whose knowledge thereof has been proven by his works. Add to this reasonable confidence in his own ability to succeed in what he undertakes, patience, and a willingness to believe that there is something yet remaining to be found out beyond what he already knows, and you have about the best that can be done in the way of an expert as things stand to-day.

One word more. Having found him, do not begrudge him adequate compensation for his work. Remember that its adequacy is not to be determined by the time required to do it, but rather by the long years of work and study that have been required to enable him to do it, and *by its worth to you*. He may give you just the missing link that was needed to make a device perfect. He may give you just the hint that will save you from straying off into an expenditure of time and money, which would only end in disappointment and failure. Remember that cheap expert opinions are like cheap law opinions, the most costly in the end, and that the very best you can get, at no matter what price that is within the bounds of reason, is none too good.

Until the time comes when men are perfect, we shall never see experts who in all respects deserve to be called perfect. It is hard for a man who has an invention of his own, either before the public or in the Patent Office—and what expert have we who has not?—to give an absolutely disinterested opinion concerning some other device for accomplishing pretty much the same thing; but this is a limitation with which we have got to struggle until there shall grow up a class of fully and broadly equipped electricians—men of knowledge rather than of genius.

THE ELECTRICAL EXHIBITION.

The building in which Philadelphia is to hold her Electrical Exhibition in the month of September is practically completed, and preparations are now making to receive the exhibits, which promise to be so numerous as to give the committee having charge of their proper installation no little trouble. It seems to be the invariable rule that, no matter how large an exhibition building is provided, the applications for space invariably exceed its capacity, so that a supplementary building, or "annex," is always called for. In the present case, the old depot of the Pennsylvania Railroad Company is to serve as annex, and the managers of the Exhibition may certainly consider themselves fortunate in having so admirable a building, ready-made and at hand, to fall back upon.

The building of the Franklin Institute, under whose auspices the Exhibition is to be held, is a busy place just now, and the gentlemen who have the work in charge find their positions no sinecures. Although the rules and regulations have been carefully drawn, with a view to doing justice to all interests and injustice to none, and although they would seem to be plain in their meaning and comprehensible to every one, would-be exhibitors find a thousand questions to ask, burdening the time and patience of gentlemen who, without thought or hope of reward, are giving their time and energy to the promotion of this great enterprise. But, despite all obstacles, the managers are making excellent progress, and the Exhibition, as a whole, promises to be one of the most interesting and complete ever held. It is very certain that no one who takes any interest in the progress and development of electrical science, and of its practical applications, can afford to miss seeing it and studying the interesting and instructive apparatus that is to be exhibited.

It is to be regretted that the managers are forced to admit that they feel themselves cramped for means, and unable to give the Exhibition and its attractions that wide-spread publicity, through announcements in the columns of the daily press, that would bring in the great public in thousands, and insure the pecuniary success of the enterprise. We believe that the public interest in electrical matters is great and wide-spread, and that if it be but properly reached and informed of the attractions presented it will flock to the Exhibition, not alone from Philadelphia and its suburbs, but from New York and very many other large cities. To accomplish this, only wide-spread publicity, and, what is sure to follow, special rates over the railroads centering in Philadelphia, are necessary. It is the public that lays the golden eggs for exhibitions, and to obtain those eggs, and as a matter of justice to exhibitors who have made liberal expenditure in order to instal and maintain their exhibits, the public ought to be invited cordially and liberally. It is all very well to answer that the managers would be glad to act upon this theory if they had the money. It is very certain that the way to get the money is to act upon this theory, and certainly gentlemen who have had the enterprise to build the building and start the enterprise ought not to hesitate to risk the few thousand dollars necessary to bring it to the notice of the great public. We speak thus freely because we think that, in confining announcements to the technical press, and to the leading Philadelphia dailies, omitting entirely the daily press of New York and other leading cities, the managers are making a blunder the seriousness of which they will not realize until they come to foot up receipts and expenditures and strike a balance at the end.

To our readers we can only say that the Electrical Exhibition will offer an opportunity to see, study and compare all that is new and interesting in electrical invention such as has never been known in this country before, and that each and every one of them who by any way can manage to get there *cannot afford to stay away.*

Mariner's Compass.

In crossing the ocean the mariner takes advantage of the position of the sun or stars, in order to tell the direction in which he is sailing. When, however, the sky is overcast and neither the sun nor the stars are visible, a little contrivance called the mariner's compass is used by him to tell the general direction in which he is sailing. Since without these instruments it would be almost impossible to cross the ocean, we will inquire more particularly as to how they are made, and why they point with such certainty toward the Polar or North Star.

There is found in many parts of the world a peculiar black stone, which is an ore of Iron. This stone possesses the very curious property of attracting to itself small particles of iron, such as iron filings or tacks. If a small fragment of such a stone be carefully balanced on a vertical support, such as, for example, the point of a needle, so as to be perfectly free to move, it will always come to rest in a certain definite position. This peculiar stone is called a magnet, and, when mounted as just described, forms what may be called a magnetic needle. A magnetic needle, formed as we have just described, would not, however, be sufficiently delicate for actual use.

The needle used in practice consists of a small light bar or needle of hardened steel, which has been rendered magnetic by carefully rubbing it with a fragment of the magnetic iron-stone, or ore we have just mentioned. Such a bar, or magnetic needle, as it is ordinarily called, when suitably suspended, is very easily moved, and when undisturbed, will always point approximately toward the north pole of the earth.

It is a curious fact that men have been enabled to cross the trackless ocean almost entirely by the aid of the unerring certainty with which this little black stone points out the general direction.

It is a mistaken idea that the magnetic needle points invariably to the true or geographical north. Indeed, in most parts of the world, it varies very considerably from this general direction, but, as we will shortly explain, allowance can be made by the navigator for these deviations from the true north, so that they do not prevent him from using the compass for this purpose.

The ends of the magnetic needle are called the poles. That which points toward the north pole of the earth is called the north pole of the needle; the other extremity is called the south pole.

Let us now inquire as to the cause of the mariner's compass always pointing in the direction in which it does. If we bring another magnetic needle, or magnetized body, into the neighborhood of a magnetic needle which is pointing toward the north, and which we will call a stationary needle, we will at once notice that the approach of this magnet changes the direction of the stationary needle. If that deflection has been caused by a second magnetic needle, and we have brought the north pole of this needle into the neighborhood of the north pole of the stationary needle, the effect of this approach will be to drive or repel the north pole of the stationary needle away from it, and to draw or attract the south pole of the stationary needle toward it. In other words, it is evident that north magnetism has the power of repelling north magnetism, but of attracting south magnetism, or stating it more generally, magnetism of the same name repel each other, while those of opposite names attract. It would seem, therefore, that the cause of the mariner's needle pointing toward the north of the earth is due to the attraction exerted by some magnet in its vicinity. It has been shown, after very many years of careful study, that our entire earth is in reality one huge magnet, with its magnetic poles in the neighborhood of, but not in the same position as, the north and south geographical poles.

Since the earth is a very powerful magnet, it would follow that magnetic needles anywhere on its surface would, if free to move, come to rest with their poles pointing toward the earth's magnetic poles. Since, too, the ends of the magnetic needle point toward the earth's magnetic poles and not toward its geographical poles, and since the earth's magnetic poles occupy a different portion from its geographical poles, it is clear that on nearly all portions of the earth's surface the magnetic needle cannot point toward the true or geographical north. Then, too, it has been shown that the position of the earth's magnetic poles is subject to a change from time to time, so that this would evidently cause the position in which the free needle would come to rest, to vary with such variation in the position of the earth's magnetic poles.

Since the north pole of a magnetic needle is attracted by the south pole of another needle, it is clear that if the cause of the mariner's compass coming to rest with one of its ends pointing toward the north pole of the earth, is the attraction of the earth's magnetism, then either that pole of the needle, that points toward the north pole of the earth, is the south pole of the needle or compass, or the magnetic pole of the earth, which lies nearest the north geographical pole, is the earth's south magnetic pole.

This difficulty has led French scientific men to call the pole of the needle, which points to the north of the earth, the south pole of the needle, and many curious mistakes have been made by translators of French scientific works from this reason. For the same reason some English scientific men use the name "marked pole of the needle" for the pole which points toward the north.

Authorities differ somewhat as to the exact time when the compass was first used for the purpose of showing general direction.

Some, for example, say it was known to the Chinese, 2,000 years before Christ; others place the date of its use by the Chinese at 1,100 before Christ. It was called by the Chinese "Fse-nan," indicator of the south. We have records that the magnetic needle was presented by the Emperor of China to the ambassadors of Tonquin and Cochin, to guide them on their homeward journey over the vast plains they had to cross. The compass was used in the fourth century by the Chinese vessels that sailed to the Indian ports on the east coast of Africa.

The discovery of the fact that the magnetic needle does not point to the true or geographical north in all parts of the world is generally attributed to Columbus, who, in crossing the Atlantic Ocean, observed that the needle no longer pointed toward the pole star. This fact caused great consternation to his superstitious crew, "who thought the laws of nature were changing, and that the compass was about to lose its mysterious power." It would appear, however, that this fact was undoubtedly known before the time of Columbus, since we find the deviation of the magnetic needle from the true north marked on a chart drawn by Andrea Bianco, in 1436.

A curious fact in connection with the magnetic needle was noticed a long while ago, namely, that the direction in which the north end of the needle comes to rest, is subject to a gradual change. That is to say, if, during one century on a certain part of the earth's surface, it came to rest with its north end pointing, say 5° east of the true north, at the end of another century it would not be found, when in a state of rest, with its north end in exactly this same direction. For example, it was shown, from observations in London, that in the year 1580 the north end of the magnetic needle came to rest some 11° east of the true north; in 1622 the north end came to rest in the position of 6° east of the true north; in 1660 it pointed to the true north; in 1692, 6° west of the north; in 1730, 13° to the west of the north; in 1765, 20° west, in 1818, 24° to the west, while in 1850 it was but 22° to the west.

Thus it will be seen that in a period of about eighty years from the date of the first observation, the needle gradually reached the true meridian, and then for about 150 years it moved gradually toward the west, and is now slowly moving eastward. The gradual variation in the position of the magnetic needle is probably to be ascribed to changes in the position of the earth's magnetic poles, and is very interesting when studied in connection with the cause of the earth's magnetism. Such variations of the magnetic needle are called secular, in reference to the cycles of time in which they occur. Besides the secular variation of the needle, there are also variations, which take place at different times of the year and are called annual, and also those which occur at different times of the day and are termed diurnal. In addition to the preceding, which take place with more or less regularity, we have the occasional violent disturbances observed in the position of the magnetic needle during the prevalence of an aurora.

Considerable light has been thrown on the phenomena of the earth's magnetism through the researches of Alexander Von Humboldt, who in 1836 inaugurated a series of simultaneous observations on the magnetic needle in various parts of the earth. These observations were made in magnetic observatories, that is, in houses built in some cases above ground, and in others below it, of materials entirely free from iron. This freedom from iron is necessary in the case of a magnetic observatory in order to avoid local deviations in the direction of the needle. These observatories were established in various parts of the world, within the Arctic and Antarctic Circles, in Africa and in North and South America. Observations were made at all of these stations at exactly the same time. It was established as a result of these observations that the different variations in the intensity of the earth's magnetism took place at absolutely the same time over all parts of its surface; for example, if, in a magnetic observatory in Africa, a disturbance of the magnetic needle was observed, it was always sure to be observed at the same time in all the other observatories. Now that we regard the entire earth as one huge magnet, we can readily understand that such must naturally have been the case, since a variation in the intensity of magnetism in one part of a magnet must necessarily affect the magnetism over all the other parts.

Driven by an Electric Motor.

PROF. TUCK'S TORPEDO BOAT SKIMMING THE NORTH RIVER AT TEN-KNOT SPEED.

Prof. Tuck's electric submarine torpedo boat was lowered into the water on Friday morning last at the Delamater Iron Works. It looks at a little distance very much as if it had been constructed by laying a large rowboat, upside down, on top of another large rowboat, fastening it there, and painting them both sea green. The shell is of iron, however. The boat is thirty feet long. It is ballasted with lead, so as to sink to the water's edge, and its displacement is twenty tons.

In the center of what may be called the deck is sunk a well hole. By a simple air-lock arrangement it affords a passage between the interior and the exterior of the vessel, even when the vessel is wholly under water. It is also the captain's look-out station, and is capped with a dome of heavy glass, so that if he chooses he can exclude the water and stand in the pit with his head and shoulders above the top of the boat, or he can leave the glass off and stand there in a diving suit. Close to his hand is a signaling steering apparatus, which transmits his orders to the helmsman down below. The boat has three rudders, one an ordinary vertical rudder at the stern, and the other two horizontal blades on the port and starboard quarters. These last help to govern the boat's movements up and down. To sink her water is pumped into her compartments; to raise her air is pumped in, and the water is forced out. Compressed air is stored aboard in six-inch pipes. There is also an apparatus for re-oxygenating air that has already been breathed. Moreover, there is a simple arrangement by which the ends of two rubber tubes can be floated up to the surface of the water and opened to the supply of fresh air up there.

An electric motor, driven by force from storage batteries, runs the propeller. The interior, which is arranged for a crew of four or five men, is lighted by incandescent lamps. An indicator shows the distance of the boat beneath the surface. The estimated speed of the boat under water is eight knots.

The torpedoes are to be carried outside the vessel, one at the prow and one at the stern. They are to be held there in iron cylindrical sheaths by electro-magnets, which will release them when the current is cut off. They are ballasted with cork, and after placing one of them the torpedo boat retires to a distance, unreeling as it goes two wires, by which, at a proper distance, the torpedo is fired.

The lead ballast proved insufficient to sink the boat below the water. A crew of three men went aboard her, however, and, with Mr. John Rice as captain, a test was made of the electric engine. It drove the boat several miles up and down the river at a speed of ten knots. She answered her rudder well. Some time this week she will be tried under water.

A New Surgical Lamp.

One of the newest adaptations of electric illumination is in the shape of a very small lantern, which can be introduced into the mouth, throat, and, in some cases, the stomach, for the purpose of aiding surgical and dental operations which cannot be carried on without light, and for which it has been extremely difficult heretofore to obtain light by mirrors or other means. Experiments have been making for some years to perfect apparatus of this kind. Since 1881 E. T. Starr, an expert in electrical science, has been working at intervals upon minute electrical lamps, in his rooms in White's Dental Establishment, at Twelfth and Chestnut Streets, Philadelphia, and at last has succeeded in getting highly satisfactory results. Patents have been obtained. The instrument has been critically examined by dentists and surgeons, and has already been used in practice.

The lamp primarily consists of a delicate glass bulb, from which the air has been withdrawn and as nearly a perfect vacuum created as possible. The bulb varies in shape, being spheroidal, flat, and compass-shaped, and also cylindrical, with a conical termination. Through the thin walls of the lantern run the conducting wires, connected by a carbon arc, on which the electricity centers, and which thus becomes the place of light. The glass lantern is very small, the cylindrical-shaped being scarcely half an inch in length, and with a diameter not nearly so great as that of an ordinary lead-pencil. The compass-shaped lamp is about one-quarter of an inch thick, and has a diameter of three-quarters of an inch to an inch, while the spheroidal seems scarcely larger than a good-sized pea. The lamp is attached to a handle from seven to nine inches long, and about half an inch thick, through which run the wires connecting with the battery. The handle and the lamp can be separated, and thus but one handle is necessary for use with the different forms of the lamps. The intensity of the power, and hence the brilliancy of the arc of light, can be regulated by moving along the handle a ring which connects with the wires. The handle has several joints, and its position can be arranged in almost any way so as to adapt it to the shape of the cavity which it is proposed to illuminate. Mirrors can also be fastened to the lamp and light reflected to places where the lamp cannot be introduced. To prevent the too great diffusion of light and the radiation of heat, the lamp may be partially covered with a hard rubber or gutta-percha case.

When the lamp is placed in the mouth of a patient every portion of the throat, even to the lowest parts, and every recess of the upper places can be plainly seen. This will greatly facilitate the work of surgery and dentistry, and enable an operator to conceive a much more thorough diagnosis of a case than the use of any other means previously known. Placed behind the teeth, the intense light renders not only the teeth, but even the gum above, highly transparent. If the teeth are good and undecayed, no lines will be visible—but the presence of a filling or of the mere beginning of decay may at once be seen. When the lamp is placed within the mouth and the lips are closed, the entire front structure of the mouth is brought to view. The bone and tooth formations are easily discoverable, and even the interior of the nasal passages. In the same way the instrument is of great value in the treatment of obstetrical disease, and in studies of the stomach. No unpleasant sensations are experienced by patients, even in cases of protracted use, no other effect being noticeable than that which follows the drinking of a hot cup of coffee.

Telephonic News

*** Mr. Geo. L. Wiley, general manager of the New Mexican Telephone Co., of the City of Mexico, is spending three weeks at his home in Rochelle Park, New Jersey; he returns soon to Mexico. Mr. Wiley reports great progress in the electrical field there during past year, and reports the outlook very promising.

*** The Sunset Telephone Company of California has laid, and has now in working order, one of the Bishop Gutta Percha Cables 4½ miles long (with seven conductors), across the bay at San Francisco to Oakland. The telephone service through this cable to Sacramento, 100 miles distant, has been, we are informed, very good.

*** We regret exceedingly to learn of the death of Mr. George L. Wheeler, superintendent of the northeastern division of the New England Telephone Company. Mr. Wheeler was one of the most promising young superintendents in New England, and his loss will be keenly felt by his company and the many friends he has made in the telephone field.

*** It is through the help of the microphone that telephony has become so practical and so extensively adopted. The Blake transmitter, the Ader, and many others, by which music and speech are now conveyed so many miles, are all varieties of the carbon microphone. In some churches, microphone transmitters are now applied to the pulpit, so that the sermon can be transmitted by telephone to invalid members who cannot leave home. At the Electrical Exhibitions of Paris, Vienna and the Crystal Palace, the music of an entire opera was transmitted from the stage by wire to other buildings, where great numbers of persons sat and listened to it. The transport of music and other sounds in no way directly connected with the wire is frequently effected by what is termed induction or leading-in. Over and over again persons listening into telephones, for the purpose of hearing what a friend is saying, have heard the strains of this music—aside, communicated by induction from some neighboring lines to theirs. Not long ago a telegraph clerk in Chicago was listening in a telephone early one morning, and to his surprise heard the croaking of frogs and the whistling of birds. The explanation of the phenomenon is that a loose joint in the telephone wire, where it passed through a wood, acted as a microphone, and transmitted the woodland chorus to his ears.

*** The *Nottingham Daily Guardian* gives a detailed description of the progress of the telephone in that town, and from its article we gather the following information: The National Telephone Company opened an exchange in Nottingham in September, 1881, the first line being put up on November 1st. At the end of that year 25 subscribers had been put into communication, and there was an average of 250 calls per day. The exchange has now 140 subscribers, the average number of calls being 1,000 daily. Over 350 miles of wire have been erected within a radius of 14 miles. The local branch of the company has also constructed lines at Burton-on-Trent, Louth, and Cromford, and is anxious to extend into other parts of Derbyshire, Lincolnshire, Leicestershire, and Notts. An endeavor has been made to establish communication between Nottingham and Loughborough, but as there is opposition from private sources that object has not yet been achieved. The corporation has availed itself to the full of the new means of communication, all the police stations and the public offices associated with the various departments being linked to the exchange, and to one another. The electricity required is generated by water force, and Gilliland's switch-boards are in use, never having failed during the two years they have been in operation. The relations of the company with the post office are stated to have been the most harmonious, but relating to the pamphlet published by the United Telephone Company upon the subject regarding which that company and the post office are at issue, the *Guardian* says: "The company complain bitterly of the conduct of the post office in impeding their action, and, indeed, so strong a case is made out, that the pamphlet requires an answer."

The Atlanta Telephone Exchange.

No better thermometer of the business life of a city—its quickening or depression—in these days of progress can be mentioned than the success or failure of a telephone exchange, though, of course, much depends upon the management. The Atlanta Telephone Exchange is exceptionally successful, inasmuch as the growth of the city's industries has been almost beyond all precedent. Only a year and five months ago the subscription list numbered but 174; to-day it is 432, with a prospect ere the close of the year of its being increased to 600, as sixty-eight new subscribers have been enrolled within sixty days. A new switchboard is being put in, capable of accommodating 1,000 wires, which it is confidently hoped will be needed Mr. W. J. Cole is the general superintendent of the Third District, which includes Atlanta, and Mr. W. T. Gentry the general manager of the exchange, and his efficient assistants deserve much credit for the success and popularity of the institution. It is refreshing to find civil attendants in positions where the quality of politeness is so generally lacking.

As an illustration of the perfection which the business has reached, we may state that lately conversation was carried on without difficulty over the Western Union line between Atlanta and Montgomery, a distance of 176 miles. Who will dare to predict the wonders of science in this direction in future years?—*The South.*

National Telephone Exchange Association.

SECRETARY'S OFFICE,
PULLMAN BUILDING,
CHICAGO, Ill., July 2, 1884.

DEAR SIR:—The sixth meeting of the National Telephone Exchange Association will be held according to a vote of the association, at Providence, R. I., commencing on Tuesday, September 2, 1884.

In view of the opening upon the same day of the Electrical Exposition, under the auspices of the Franklin Institute, at Philadelphia, upon the suggestion of Mr. Theodore N. Vail, your Executive Committee has voted that it is expedient that the meeting, as soon as it is called to order at Providence, should be adjourned to meet at Philadelphia the following day (Wednesday, September 3, 1884). Under the by-laws, two or three members can act as a quorum for the purpose of adjournment. The Executive Committee can arrange that this shall be done without requiring the presence of all the members at Providence. The Providence Telephone Company, whose invitation to that city was accepted by the Cincinnati meeting, has very gracefully extended its invitation to the year 1885.

The Executive Committee will wait two weeks for the filing of objections to this proposed change. If any considerable number of objections are filed with the Secretary, the members of the association will be notified thereof, and the meeting will be held at Providence as originally ordered by the association. If no objections are filed within two weeks, the Executive Committee will make arrangements for hotel accommodations at Philadelphia, and notify the members of the association in the usual manner, and will provide for the formal meeting at Providence and adjournment to Philadelphia. In this event the meeting will be called to order at the office of the Providence Telephone Company at 10 o'clock A. M., of September 2.

The following amendments to the constitution are to be acted upon at this meeting:

Proposed by Mr. Fay. "That Article III of the Constitution be amended by striking out the first clause and inserting the following: 'The members of this association shall be directors, or general officers not below the rank of superintendent, of corporations holding exchange licenses from the American Bell Telephone Company, or individuals holding such licenses. Each member shall be entitled to one vote, and corporations now holding membership may transfer the same to their proper representatives—one representative being allowed for each vote heretofore held.'"

Also: "That Article VI of the By-laws be amended by striking out everything before the word 'together,' and inserting the following: 'Whenever any individual desires to become a member of this association, he shall make application for membership and forward the same to the secretary.' The remainder of the article being as heretofore."

Proposed by Mr. Estabrook. "That the convention at its annual meetings, by a two-thirds vote of the members present, shall designate the time of holding the next annual convention." Very respectfully,

C. N. FAY, Secretary.

On Underground Wires.

Editor Electrical Review:

DEAR SIR,—In a recent issue of the London *Electrical Review*, I noticed an article on placing telephone wires underground, which, I believe, first appeared in your publication. While agreeing with the author in many points, I cannot pass unnoticed the following paragraph, which is liable to mislead those who have not made the subject of insulation a special study: "I have, however, very little faith in coal tar, pitch or bitumen, as they have very little insulating power, and the durability of the wires embedded in them is at best doubtful." However it may be with coal tar and pitch, the statement as to bitumen is certainly incorrect. It is common, but none the less an error, to confuse this mineral with the manufactured or by-product pitch, from which it, in reality, widely differs. For many years electricians, both in this country and in Great Britain, have appreciated the electrical qualities of bitumen, and numerous experiments have been made to adapt it to the purpose of insulating, with, until comparatively recently, no success, as the bitumen has always remained viscid "creeping." It has been left to Mr. Callender, of London, to accomplish what so many have failed in doing. Recognizing from the first that bitumen, in its natural state, was not what was wanted, Mr. Callender set himself to so change its nature that it would neither flow nor melt, and that it would become solid and elastic The result is his patent vulcanized bitumen or bitite.

This material much resembles india-rubber in look, smell and touch; has many of its valuable qualities, and, being a mineral, is admirably adapted for underground purposes, it does not dry up, neither do insects attack it, nor does it appear to be affected by any gases. For the last two years and a half Mr. Callender has been manufacturing wires, insulated with his material, in England, and has met with decided success in his manufactures, being well known throughout Europe. The electrical qualities are good; 16-copper wire, insulated to $\frac{1}{16}$ in water at a temperature of 60° F., gives a resistance of from 300 to 400 megohms per mile.

The well-known London electrical engineers, Clarke, Forde & Taylor, reported last year upon this material as follows: "The insulation appears to be very good, and too high to be measured directly, even with an electromotive force exceeding 200 volts and Sir William Thomson's reflecting galvanometer. By means of the 'loss of charge' method, we make the resistance of the core and bedding 1750 megohms per statute mile at the temperature of the air (56° F.), which is high enough for practical purposes." And again, in February of the same year, they report: "A 50 ft. length of core was suspended with a sag of about 18 inches, and a current of 190 amperes run through it. The heat caused by this current soon rendered the insulating material soft, without, however, affecting its elasticity or shape. After about two hours the current was taken off, and the core allowed to cool in the same position. After about twenty hours, a short length was cut out of the center and opened, showing the conductor still in a perfectly central position. We therefore think that, having regard to its cost, the core is likely to prove well adopted for electric lighting and other similar purposes, as there can be no reason to doubt that its insulating and other properties will be found permanent."

These eminent engineers do not agree with the author of the article before referred to in his estimate of bitumen.

A material giving an insulation resistance of 1750 megohms per mile, and the core in which does not become deantred with the tremendous current of 190 amperes flowing through it, is not one to lose faith in. I think the above reports are amply demonstrative of that which I wished to bring out, viz., that bitumen should not have been classed with coal tar and pitch, and that it is not only a good insulator, but that of the durability of the wires embedded in it there can be no question.

Mr. Callender now finishes his cables by taping, and again passing them through the bituminous compound; this prevents absolutely any liability to crack. The vulcanized bitumen cable, as thus prepared, should, for either aerial or underground purposes, rank among the first.

JAS. F. KELLY,
Electrician for the Electrical Supply Co.
17 Dey Street, N. Y.

The Baltimore and Ohio, the Bankers and Merchants', and the Postal Companies Enter into a Pooling Agreement for Twenty-five Years.

The terms of the alliance between the Baltimore and Ohio, the Postal and the Bankers and Merchants' Telegraph Companies, which have been under consideration for several weeks, were finally agreed upon last Wednesday. This agreement, which will go into effect on the 31st of this month, practically consolidates the three rivals of the Western Union into one great enterprise. It is stated that this is the fulfillment of a long cherished project of Mr. Garrett's, viz., a great telegraph system of which the Baltimore and Ohio should be the nucleus.

The contracts, which were signed the 17th inst., provides for a pooling arrangement which shall last for twenty-five years, and under the terms of which each company is to receive about an equal percentage of the earnings. Each company will continue to maintain its individual organization, but the offices and working force will be consolidated and the management of the enterprise will be in the hands of the united Executive Committees of the three companies. No changes can be made in the policy of the consolidated system except by unanimous consent of the representatives of each company. Should any serious disagreements arise the contract provides for the appintment of arbitrators. John W. Mackay, Robert Garrett, James Gordon Bennett and other capitalists will be in the Joint Executive Board. D. H. Bates, President of the Baltimore and Ohio Telegraph Company, will be the Executive Manager, and G. S. Mott, of the Bankers and Merchants' will be General Manager.

The union of these three companies brings under one control more than 16,000 miles of pole line and 120,000 miles of wire, connecting all of the principal cities east of the Missouri River and southward as far as Galveston, Texas. The total mileage of wire of the new combination is equal to about one-third of the Western Union mileage, omitting railroad wires, but this one-third, by reaching the most important trade centers, reaches about eighty per cent. of the entire paying telegraphic business of the country, with complete facilities for handling the business The united companies will have four lines between New York and Boston, with branches to Newport and Fall River. They will also have four lines between this city and Philadelphia, Baltimore and Washington. There will be five lines between New York and Chicago, having in the aggregate fifty wires, including the telegraphic lines of the West Shore and Nickel Plate Railroads. Two com-

plete lines, with convenient branches will run through the oil regions between Buffalo and Pittsburgh. The lines west and south are now being extended, and additions will be built to meet the demands of business.

The combination includes a complete stock quotation or ticker system, which is now in operation in this city and Philadelphia, and which is soon to be started in Chicago, Boston and all of the principal cities; also a well-established district and telegraph messenger service, and a complete telephone system in many of the larger cities. The entire consolidated system will be operated in connection with the Bennett-Mackay ocean cables. In this arrangement between the three companies neither assumes or becomes responsible for the fixed liabilities of the others. Their joint control and management, it is stated, will be composed of the best talent and financial strength of the three companies. The expenses of operating will be reduced as nearly as possible to the cost of running one company, and the business will be extended wherever and whenever there seems to be need for it.

Before the signing of the contract there was a full understanding between the three companies that extensions of lines now under way should be completed and paid for independent of the combination. It was stated that provision had been made by each company to raise all of the money required to finish their several extensions. The Bankers and Merchants' will need about $500,000, the Postal Telegraph Company will need about $255,000, and the Baltimore and Ohio Company expects to expend about $250,000. The actua cash cost of the property embraced in this consolidated system is estimated at about $18,000,000. Within four months 20,000 miles of new wire were put up by the Baltimore and Ohio Company, and 5,000 miles more are in progress of construction. The total mileage of the Baltimore and Ohio will be 45,000 miles of wire by August 1.

The Gulf, Colorado and Santa Fe Railroad of Texas, which has been doing public telegraph business in opposition to the Western Union Company for several years, will join the combination, and in connection with the Baltimore and Ohio will build lines to all important cities and towns in Texas.

The Bankers and Merchants' Telegraph Company have increased their wire mileage during the last six months from 30,000 to 55,000 miles, reaching the Southern States to New Orleans, stretching West as far as St. Paul and Omaha, with ten through wires from New York to Chicago. The Postal Company are also adding wires and perfecting their system, and will have ten wires in all between New York and Chicago, besides wires to Boston and Washington. The Baltimore and Ohio and Bankers and Merchants' Companies now lease wires to brokers, merchants and others aggregating in mileage, it is claimed, nearly as much as the Western Union mileage of leased wires, at rates considerably less, the aggregated annual rental amounting to nearly $400,000. A telegraphic money transfer system will be a prominent feature of the new combination, and the district messenger system will be extensively developed in all large cities.

At the meeting at which this pooling agreement was finally determined upon the following named gentlemen were present: D. H. Bates, of the Baltimore and Ohio; G. S. Mott and A. W. Dimock, of the Bankers and Merchants'; George D. Roberts, H. Cummins George S. Hart and Henry Rosener, of the Postal Telegraph Company. The first conference at which this consolidation of interests was discussed was held at Long Branch, July 4, and was attended by Robert Garrett, D. H. Bates, George D. Roberts and H. Cummins.

Vice-President Cummins, of the Postal, said last Tuesday that the new combination would reduce the rates to the basis of the Postal's rates, which are very much lower than those of the Western Union. On that basis he believed that the pool would be able to clear between $1,200,000 and $1,500,000 a year. He thought that about one-half of the offices now maintained by the three companies separately could be closed and that the operating expenses would be reduced at least one-half within a year.

Officers of the Western Union Company authorized the following statement:

"Nearly all of the points reached by the new telegraph combination are reached by the Mutual Union wires, and every time the Baltimore and Ohio makes a cut the Mutual Union will meet it, and perhaps go a little lower. The Western Union company will go on its usual way without regard to the new combination."

Unequaled Conditions for Deserving Public Confidence.

Recent movements toward the consolidation of an opposition to the Western Union land lines of telegraph and to the eight Atlantic cables working in connection therewith, render it time to call attention to the respectability and power of the interests involved in the maintenance of the established system of Atlantic cable telegraphy.

The importance of having the Atlantic cable service under the control of the most responsible representatives of varied and distinct interests will be conceded by all intelligent men, and has been recognized, not only in the character of its direct management, but in that of the companies and governments, on each side of the Atlantic, that direct or control the connecting land lines.

A few names and facts will establish this proposition far better than many columns of argument. We present the names of the directors of the Anglo-American Telegraph Company, as follows:

Chairman, Right Hon. Viscount Monck.

Sir James Anderson, Cyrus W. Field, Esq., William Barber, Esq., Sir Daniel Gooch, Bart. M. P., Francis A. Bevan, Esq., Marquis of Tweeddale, W. S. Cunard, Esq., H. Weaver, Esq., Managing Director.

The Directors of the "Compagnie du Telegraph de Paris a New York," which is in the closest working relations with the Anglo-American Company, are as follows:

President, M. Pouyer-Quertier.

M. Ch. Le Cesne, M. de Circourt, M. le Comte d'Hespel, M. de Lambertye, M de Remy de Courcelles, M. le Comte de Valon.

The third of the cable companies which are practically consolidated, for their own and the public interests, is the Direct United States Cable Company, whose directors are as follows:

Chairman, John Pender, Esq., M. P.

The Hon. Sir Henry Keppel, G. C. B., D. C. L., William Ford, Esq. Admiral R. C. Mayne, C. B.. C. J. Gunther, Esq., Charles Meara, Esq., Lord Hawke, E. M. Underdown, Esq.

The fourth of the allied companies is the American Cable Company, which is leased to the Western Union Telegraph Company.

Now that the cable is more and more freely used for the transmission of the most confidential business, and for diplomatic and personal messages, it becomes of the highest public interest that the character of the companies, or other agencies, who control the business to, through and from the Atlantic cables should be such as to inspire absolute confidence.

This condition of confidence is secured for the consolidated cable companies whose Directorates we have given, beyond all question.

For, it is the English, French and German governments who control, on the other side, all the telegraphic business to, through or from the Atlantic cables, as postal telegraphy is the established system in these three great countries. There is no need of adding words to this simple statement of fact.

On this side of the Atlantic the telegraph company that controls the business to, through and from the consolidated Atlantic cables, is the Western Union, whose Directorate is without its equal—or even approximation thereto—in the world. It contains a larger number of financiers of the foremost position, strength and representative responsibility than are combined in any other half-dozen corporations. Any intelligent man who looks over the list of directors of this corporation will see at once how vast, varied and often conflicting are the interests represented in this board by their very ablest men. Here is the list of these directors, which will bear careful study, viz.:

John J. Astor, Frederick L. Ames, C. C. Baldwin, William D. Bishop, James W. Clendenin, A. B. Cornell, Chauncey M. Depew, Sidney Dillon, Harrison Durkee, Thomas T. Eckert, Cyrus W. Field, Norvin Green, Jay Gould, George J. Gould, John Hay, C. P. Huntington, H. J. Jewett, R. L. Kennedy, George D. Morgan, J. Pierpont Morgan, J. Pender, M. P., London; Percy R. Pyne, George B. Roberts, Russell Sage, Samuel Sloan, John T. Terry, John Van Horne, Henry Weaver, London; Erastus Wiman, Frank Work.

The names we have published will suggest to thoughtful men the strength, the respectability, the high character and the unapproachable security for guarding the public and private trusts committed to the land and cable lines of the great consolidated telegraph system, guaranteed by the strongest governments and the ablest and best business men on both sides of the Atlantic. All well-informed individuals will see in the very organization of the companies that are combined for giving land and cable telegraphy to the most important parts of the civilized world, the overwhelming proof that the one business which needs most to be in the hands of the best and most responsible parties has secured for its management coalitions of business ability, immense personal wealth, high personal standing and representative membership.—*The Mail.*

.... A message of sixty-nine words was forwarded by the Governor of Victoria announcing the opening of the Melbourne Exhibition on that day. The message was dispatched from Melbourne at 1 P. M., and reached London at 3.48 A. M. on the same day, or 9 hours 17 minutes *before* the hour of its dispatch. Allowing, however, for the difference of time between the two cities, it occupied only twenty-three minutes in transit. The route of the message was over the lines of the Victorian and South Australian Colonies, the cables of the Eastern Extension Australasia and China Telegraph Company, the lines of the Indian Government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French Government, and the rapidity of its transmission shows the harmony with which the various administrations work together. The total distance traversed was 13,398 miles.

.... Our Southern correspondent says that the announcement of the pooling arrangement between the Bankers and Merchants', the Baltimore and Ohio, the Postal Telegraph and the Commercial Cable companies meets with marked approval and gives general satisfaction throughout the South. The Southern Telegraph Company, which is a part of the Bankers and Merchants' combination, is already making a strong competition with the Western Union for business in this section, and as its lines are extended the prospect for cheaper rates becomes more apparent. This company's lines, which run from Washington to Richmond, thence to Norfolk, Lynchburg, Charleston and Savannah, have recently been extended and completed to Montgomery, Ala., and will soon be open for business at Macon, Ga., Selma, Ala., and other Southern points. The material is also being rapidly accumulated for the further extension of its lines to Mobile and New Orleans. Another branch is also being constructed from this city, *via* the coast, to Wilmington, N. C., Charleston, S. C., and intermediate points, with the prospect of ultimately reaching all important points in southeastern Georgia and Florida. The new company has received the most liberal patronage and flattering encouragement from the Southern public. This, coupled with the statement that the new pool will hasten the completion of its Southern lines and produce a consequent improvement in service and reduction of rates, gives assurance that successful competition with the Western Union will soon be opened at all points, to the advantage of the general public.

TELEGRAPHIC

.... The Baltimore and Ohio Telegraph Company's new schedule of rates went into effect Monday last. Day rates are reduced to twenty-five cents for ten words between New York and Chicago, and night rates to fifteen cents for fifteen words between all points east of St. Louis.

.... There was great rejoicing in Waterville on the 19th ult. over a message received from the electricians on the steamer Faraday, who are laying the new Mackay-Bennett cable. They have kept themselves constantly in communication with the Irish terminus at Waterville through the cable which they are laying, and on the 19th the officials on shore received the welcome news that the Faraday had arrived at the buoy in mid-ocean which marks the end of that portion of the line which was laid from America. The news was soon spread in London and Paris, and messages of congratulation have ever since been pouring into the little office at Waterville.

.... For the quarter ended June 30, 1884, the telegraph service in England yielded a revenue of £440,000, as compared with £390,000 for the quarter ended March 31, 1884; £435,000 to December 31, 1883; and £485,000 to September 30, 1883. For the year ended June 30, 1884, the receipts were £1,750,000, against £1,735,000 for the year to June 30, 1883. The *Times*, in reference to these statistics, says: "Mr. Childers postponed the proposed reduction in the charge for telegrams until August, 1885, on the ground that the Parcel Post had not fulfilled his expectations; but the increase of £5,000 in the telegraph revenue for the quarter will strengthen the argument of those who hold that the cheapening of one important service should not depend upon the success of another."

.... Owing to the peculiarity of the Chinese characters, each of which represents a word, not a letter, as in our Western tongues, the Danish Telegraph Company (the Great Northern), working the new Chinese lines, have adopted the following device: There are from 5,000 to 6,000 characters or words in the ordinary Chinese language, and the company have provided a wooden block or type for each of these. On one end of this block the character is cut or stamped out, and on the other end is a number representing the character. The clerk receives a message in numbers, and takes the block of each number transmitted, and stamps with the opposite end the proper Chinese character on the message form. Thus a Chinese message sent in figures is translated into Chinese characters again and forwarded to its destination. The sending clerk, of course, requires to know the numerical equivalent of the characters, and have them found for him.

.... The appropriation of $20,000 by Congress for the establishment of a signal station at Nantucket, and the laying of a cable connecting the island with the mainland, causes great rejoicing. It is believed that in the fall an additional appropriation will be secured, and that before the winter is over the island will enjoy the blessing of direct communication with the continent. No place of similar size on the continent is so isolated from the outside world during the winter season. The boats from Woods Holl run irregularly, owing to the uncertainty of the weather, and many a person who has ventured to go to the island in the winter season has remained a prisoner there for a week or more, deprived not only of means to get away from there, but of means to communicate with his family and friends. There are many wrecks off the shore of the island, and oftentimes a long time must elapse before the details are known. The value of a cable as a means of transmitting shipping news can hardly be over-estimated. With the completion of the cable, the island will make a new start in life, and will become even more popular than it now is as a watering place. Heretofore, many have kept away because of the absence of telegraphic communication.

ELECTRICAL AND SCIENTIFIC

* * The practical applications of the dynamo-electric machines to the art of electro-metallurgy will be quite fully shown during the approaching exhibition.

* * An attempt is being made in England to utilize electricity as a motor for tricycles, the prospectus of a company having been issued. It is proposed that 100 persons bind themselves to buy an electric tricycle at $250, or, in other words, that shares of $250 each be issued, each holder of a share being entitled to be supplied with an electric tricycle. The first machine to be produced is an electric tricycle carrying two persons, and fitted with battery and motor sufficient to propel it on level ground at the rate of six miles an hour.

* * At a recent meeting of the Electro-Chemical Society of Berlin, Dr. Aron exhibited specimens of a vegetable carbon made conductive and incombustible by being strongly heated either in vacuo or in a neutral atmosphere. This artificial graphite does not assume the crystalline structure of the native mineral. It has long been known that graphite could be formed by the influence of high temperature, under special conditions. Dr. Aron has now shown that by the same influence soot can be rendered as good a conductor as graphite.

* * It may not be amiss briefly to state the advantages to electro-metallurgy which, in our opinion, are secured by the use of the dynamo electro-plating machines over the old form of voltaic battery. These are briefly as follows, namely: the dynamo-electric machine is always ready for action; the mere act of slipping a moving belt on its driving pulley enables it at once to furnish the requisite current. The necessity for dealing with expensive and corrosive liquids is thus entirely obviated. The dynamo-electric machine furnishes, for extended periods, a much steadier current than that produced by the battery. At least, the dynamo-electric machine is not subject to the same loss in the intensity of its current that is characteristic of all batteries, and that loss arises either from their polarization or from the exhaustion of their electrolytic liquids. It will follow, therefore, that less difficulty is experienced in maintaining constancy between the current strength and the strength of the bath on which good electro-plating work is largely dependent. On the score of economy, the dynamo-electric machine is far ahead of the voltaic battery for the purposes of electro-metallurgy.—*The Bulletin.*

* * One of the most remarkable instances of the transmission of power by electricity is that presented by the electric railroad in one of the main crosscuts of the Oppel colliery, Saxony. This crosscut, it appears, is some 2,362 feet long, and is the outlet for the coal mined in the vein, the quantity delivered to it being six hundred mine cars per day of sixteen hours, each car containing 1,047 pounds of coal, and weighing, loaded, 1,594 pounds. The plant was substantially modeled after the Siemens. In practice, a train of fifteen cars is moved at a speed of from 7.4 to 9.8 feet a second, the steam engine at the mouth of the shaft making from 225 to 250 revolutions during the run, lasting from three and one-half to four and one-half minutes, through the crosscut. When doing this amount of work, the steam engine delivered, according to brake trials made, 11.2 horse-power; or, assuming the friction of the engine's gearing to have occasioned a loss of twenty-five per cent., the power actually transmitted by the electric current to the locomotive was 5.22 horse-power, or 46.6 per cent. The consumption of steam, with a pressure of sixty-five pounds, is estimated at 45.6 cubic feet per round trip of fifteen cars. An estimate of the cost shows that there are probably many cases in which the transmission of power by electricity would pay well.

* * One of the most efficient forms of railway electric signals, as proved by experience, is that operated on the principle of the closed or constant electric circuit, the rails being used as conductors. The track is divided into mile sections, and at one end of the section is placed a battery, one pole being connected by wire with the rails of one side of the track, while the other pole is connected by wire with the rails of the other side; at the other end of the section is placed the signal, moved by a weight or spring, the latter controlled by an electro-magnet. As is well understood, when the electro-magnet is excited it causes the signal to take the safety position, and when the electro-magnet is demagnetized it causes the signal to indicate danger.

* * *The Bulletin*, of the Philadelphia International Electrical Exhibition, publishes the following for the information of exhibitors: The buildings are now finished and ready for the preliminary arrangements to accommodate exhibits. The foundations for engines are completed in some localities, and in others the work is being pushed forward. The boilers, consisting of Babcock and Willcox, Root and Abendroth, the Harrison boiler, Dickson Manufacturing Company, Burnham, Parry, Williams & Co., and others are in process of erection. In fact, everything is being done that energy can accomplish to have the exhibition ready for visitors on September 2. The committee urge upon all who have applied for space to begin preparations for installations. A staff of assistants to the superintendent can always be found at the buildings, Thirty-second and Lancaster Avenue, to give information, or letters of inquiry addressed to the Committee at the Franklin Institute, will secure an immediate reply. Those who have not yet applied for space and desire to do so, can have blank forms furnished giving all information. If these are promptly forwarded, the Committee will endeavor to find locations to accommodate. It is but frank to say, however, that there is a pressure for space that may prevent those who apply at a late period from securing as large an area as might be desired. In arranging for the exhibition it was determined to use every effort to have all electrical appliances represented, and this motive prompts the desire to find room for interesting and novel displays, even if it shall cause some extra planning and work for the superintendent.

* * Although the systematic search for the philosopher's stone was given up many years ago, its modern counterpart still exists in the minds of a few who expect economically to transmute the baser form of carbon into the priceless diamond. The latest enthusiast in this field has gone to the trouble of erecting quite an extensive apparatus by which, with the help of a force of nature, in the manifestation of a flash of lightning, he hopes to attain some tangible result. The experimenter, who is a correspondent of *The English Mechanic*, described his device as follows in a recent issue of that publication: "If a source of heat could be obtained of sufficient intensity to liquify carbon or charcoal," he asks, "would it on cooling assume the same crystallized form as glass? The question is, How can a heat be obtained some thousand times greater than can be produced by any quantity of galvanic cells or dynamo machines? I propose to utilize a flash of lightning in the following manner: I have erected in my garden a long iron conductor attached to a wooden spar firmly fixed in the ground, and three wide ropes as stays. This is about forty feet high, and the conductor extends twenty feet above it. On the top of the conductor is fixed a copper ball eight inches in diameter; the rod is attached to the spar by iron clasps insulated with gutta-percha. The rod is bent about two feet from the ground, leading into a wooden box containing a tube of biscuit earthenware, and about one inch inside diameter and one foot long. The end of the rod is connected to a piece of copper wire one-half inch thick, and passes about one inch into the end of the tubes. The other end has a rod connected the same way, and passes down into the earth. The tube is filled with charcoal or any other carbon. Mr. Swan (of electric light celebrity) suggested lampblack; but this or any other conducting material could be inserted. An earthenware tube I consider preferable to glass, for if an explosion took place, which probably would, the effects on the carbon could be better seen than among broken glass. I have never yet been fortunate enough to have the conductor struck, as thunder storms are not very frequent in this neighborhood."

Electric Lights on the Common.

A sensible opinion. A correspondent who is an expert in the electric lighting business writes to the *Daily Transcript* concerning the removal of electric lights from the Common. Had the committee on lamps, instead of replacing the electric lights with the gas "torches," contracted for electric lights to burn till 12 o'clock midnight, and after that hour used the ordinary gas lights, the cost to the city of the five electric lights would have been but $2.50 per night, and the additional cost of the small gas lamps after midnight would have made the expenses very little in excess of the present cost. And everyone will admit that the mall in question would have been lighted, at least up to midnight. But I assume that light and protection, and not the saving of a few cents per night, is the true policy of the city in this respect, and that a sad mistake was made when the electric lights were taken off the Common. In the city of Hartford, where the gas lamps, burning twenty-six nights per month, cost the city $35 each per annum, experience shows that each electric light displaces six and a half gas lamps and gives at least ten times the light, as the street commissioners say in their report to the City Council. At sixty-five cents each, these electric lamps, burning twenty-eight nights per month, instead of twenty-six, as the gas lamps did, cost the city $211.90 per annum each, against $227.50 for the six and a half gas lamps, showing a saving of $15.60 per annum for each electric light. If this is the case in Hartford, why not in Boston? Simply because in Hartford the committee has been fair and friendly to electric lighting, while in Boston the committee has been wholly in the gas interest.—*Boston Globe, July* 20, 1884.

Secondary Battery Cells.

Mr. Frederick John Smith, B. A., has kindly sent us the following communication:

"Considerable trouble has been felt by those who are engaged in practical problems connected with secondary batteries, arising from imperfections in the cells for holding the dilute acid, and also from the fact that the plates of a charged secondary battery cannot be lifted out of the liquid, in order that any required area may be exposed to the action of the acid, without the rest of the reduced lead on the cathode plates being at once acted on by the oxygen of the air. To meet these difficulties I have carried out the following methods:

"The cells are made of common pottery ware, about 2 c. m. thick; all sharp corners should be avoided in the moulding of the cells, because they do not stand the process of cooling well, while rounded corners seldom crack during cooling. These rough porous cells are warmed slowly, in an oven, to such a temperature that paraffin-wax melts easily when rubbed against them. The cells on being removed from the oven are partly filled with paraffin-wax; this is made to run well over the whole inner surface of the cell. As soon as the wax begins to set, it is poured out, and the cell is put away to cool. A cell so made stands acid well, and the dilute acid does not creep up the sides of the cell, as it does in the common glazed cell.

"Another method, used at an earlier date than the one just mentioned, was to make deal boxes of the size required, and place inside them card boxes (held out by sand), so that there was a space of about 1 c. m. between them. This space was filled with common paraffin-wax, then the card box being removed, a perfect lining of wax was left. This method is more costly than the last, but has the advantage of greater strength. The test of two years' constant use has shown that both these forms of secondary battery cells are both practical and lasting.

"When using a secondary battery in the laboratory, it would be sometimes convenient to be able to expose only some part of the plates to the action of the dilute acid, but as things now are, this cannot be done without the part of the plates which are lifted out being at once acted on by the oxygen of the air. To prevent this action taking place, the plates are drawn out of the liquid into the vapor of benzol. (After several experiments with different gases, this appeared to answer well and to be easily managed.) By this means the injurious action mentioned is prevented, and any required amount of surface of plate may be exposed to the action of the dilute acid."—*London Electrical Review.*

The Electrical Exhibition.

We are indebted to the Franklin Institute for the following illustration. An excellent idea of the appearance of the Electrical Exhibition Building and its annexes, of the present state of which a notice is subjoined, is conveyed by the cut on the following page. The observer is standing on the line of Market Street, looking north, commanding the main building on the Lancaster Avenue and Thirty-second Street, on its south and east sides. In the Pennsylvania Railroad depot, which appears on the right, the large hall of the restaurant, the windows of which are under the broad piazza roof at the southwest corner, and the large general reception room in the middle, are to be occupied for the purposes of the exhibition, the larger hall being used for a lecture room.

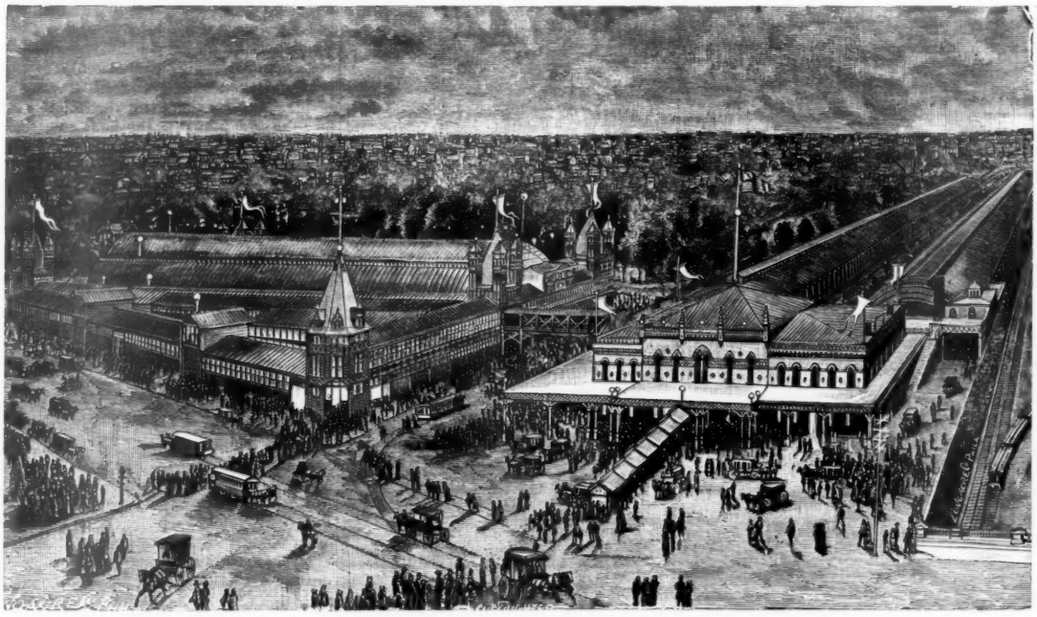
The main hall is rectangular in outline, with a triangular extension of lower elevation on the south side. The south and north sides "produced," as geometricians say, would intersect, but they are intersected some distance this side of the point where the apex of the triangle would be by Thirty-third Street. The south side, however, so approaches the north that the west side of the building is much shorter than the east. This must be borne in mind, particularly with reference to the interior, in order to form any clear idea of its general plan.

The length of the main building between the middle doors on Thirty-second and Thirty-third Streets, is 283 feet; and the width along Thirty-second Street, from Foster to Lancaster Avenue, is 160 feet. The tower which stands out so prominently in the cut at the northeast corner, is sixty feet high, and a corresponding tower stands at each of the four corners of the arcade, the two on Lancaster Avenue having the entrances cut through them, with ticket offices and parcel and package rooms on either side.

From the middle of the east front rises a tower with high sloping roof, from the four corners of which spring four turrets, instead of the four dormer windows of the southeast entrance tower, while from its front will project the bridge leading to the depot. The other towers are similarly constructed, and each turret forms a lofty balcony commanding a wide view over the city. Each front is about one-third glass, and is decorated with shields for the arms of the different States, etc. The four towers just described stand at the four corners of what may be called the nave, a noble arcade of fine Gothic arches of open frame work supporting the roof, and sustaining, in conjunction with a legion of light columns, a broad gallery running along the entire width of the east and west fronts and along the north and south sides of the arcade. But this will be more particularly noticed in the description of the interior. The south side of the building, like the others, is all windows in the upper part, and its outline is interrupted by the gables over the middle door of exit. The north side is two stories, quite plain, with the same proportion of glass, both above and below, as on the other three sides, thus flooding the interior with light. A pleasing variety in the appearance of the fronts is secured by the arrangement of the woodwork, the different sizes and widths employed, the introduction of shingles, and by other tasteful ornamentation, while the towers and gables,

and the different levels of the various roofs, give the whole structure to the eye the effect of a dignified and graceful pile of buildings, in the erection of which, considering their temporary purpose, the three important objects of cheapness, utility, and beauty had been kept in view and attained as far as possible. The exterior at present is covered with a yellow wash, about the beauty of which tastes may perhaps vary, but which is at least neat, while it harmonizes with the general tone of the structure.

Entering the building by the large door on Thirty-second Street and looking west, the whole internal plan of the structure is commanded at a glance. Before you is the fine arcade of the nave, with the pond and pedestal for the fountain in the middle, the gallery hanging round the four sides part way up the open frame work of the Gothic arches. This is the principal section of the interior, which, except as it is interrupted by the line of the arches, the light supporting pillars, and as narrow rooms are partitioned off at the ends, is all before you in one wide open space, which, however, is roofed in at different elevations. Thus immediately next the arcade on the south is a one-story shed extending nearly the length of the building, constituting a separate aisle; next to that is a higher elevation divided by pillars into three



aisles, but interrupted above and reduced for a portion of its length to one story, that additional light may be obtained by the introduction of more windows. All the interior is in the plainest of woodwork, though the office partitions are oiled, and much of the rest will doubtless be hidden by decorations, stained, painted, and otherwise improved. No partition reaches to the ceiling, except, of course, those formed by the walls of the towers, of which all four in their upper floors are to be used for committee rooms. The galleries and tower rooms, and balconies above them are reached by old-fashioned English stairways, with many turnings and a broad landing at each angle. The north and south galleries, over the main hall, are to be widened eight feet each, a measure rendered imperative by the increasing demands for space and the impatience of exhibitors, some of whom say that to get up the display they wish to make they ought to begin work at once. The entire interior has been taken up, and more space is wanted than can be allotted in quite a number of cases. Under the north gallery foundations are being dug for the engines and dynamo machines, one of the finest of which will be put in as part of the Edison exhibit, which is to take up a large portion of the east end of the building.

North of the main building, and extending its entire length along Foster Street, is the boiler house, in which two huge brick stacks are already under way, and preparations are well advanced for others, as several will be necessary to supply the power to the row of engines that will stand like horses in their stalls against the north side of the main hall, and the long cold air box, two feet high, and running the whole length of the square, is already in position and ready for the fan that is to revolve at each end. The principal offices form a row against the east front, divided by the half partition from the open area of the interior, and as yet unfurnished save with a watchman's indicator and a telephone. The ticket offices contain not only racks for tickets, but rows upon rows of shelving divided into large pigeon holes, where packages belonging to exhibitors and visitors may be checked and stowed away. Four large spaces on the floor of the main hall are to be assigned to the principal exhibitors, Edison having one of them.

The roofs as viewed from above present a bewildering array of ups and downs from the domed arch over the arcade to the peaks of the towers and turrets and the gradual slope of the lower sheds over the south wing; but within the building the eye roams uninterruptedly along under the rafters, and this opportunity for general survey cannot but add materially to the effect of the exhibition as a whole, unless it should be to some extent interrupted by the arrangement of the decorations and exhibits. From the galleries the *coup d'œil* of the arcade, with the illuminated fountain in the midst, will be extremely striking. Besides the main entrance at Thirty-second Street and Lancaster Avenue, there is to be one in each of the other towers, and five independent exit doors are provided for regular use, with others that may be thrown open at a minute's notice in case of emergency, so that the aisles, however crowded, could be emptied almost immediately. Imposing, however, as the structure is now, even in its unfinished condition, no proper conception can, of course, be formed of the appearance it will present when complete, with its decorations inside and out, and connected with the old Pennsylvania Railroad depot by the ornamental bridge. The exhibition will open September 3.

An attempt is being made in England, in a modest way, to utilize electricity as a motor for tricycles, the prospectus of a company having been issued. It is proposed that one hundred persons bind themselves to buy an electric tricycle at $250, or, in other words, that shares of $250 each be issued, each holder of a share being entitled to be supplied with an electric tricycle. The first machine to be produced is an electric tricycle carrying two persons, and fitted with battery and motor sufficient to propel it on level ground at the rate of six miles an hour.

The new electric lighting station built at Saratoga, N. Y., by the American Electric and Illuminating Company, of Boston, was was formally opened last Monday night, for use before being delivered over to the Saratoga Electric Light Company, for which it has been built. Invitations were issued by Manager Cushing to the town officials and the business men of Saratoga, as well as to a large number of the visitors at the principal hotels. At 8 o'clock the elegant new station was thronged by the elite of Saratoga, who were met by Hon. E. H. Peters, Surrogate of the county and president of the Saratoga company. Mr. Cushing, manager of the company, and Messrs. E. E. and H. T. Downs, of the Union Telephone Company, both directors of the new company, and President Goff, of the American Company, were also present, and assisted the officers of the company here in entertaining the visitors and explaining the peculiar merits and advantages of the American or Thomson-Houston system. A large number of ladies were present and all were delighted with the exhibition.

The substantial manner in which this station has been constructed and the excellence of the light has converted the entire community, and the verdict of success is universal.

The station is built for a capacity of 200 lights, with 100 in operation. Several prominent and distinguished gentlemen from England and France were present, who are familiar with the different electric light systems in Europe, and they were very strong in pronouncing the Thomson-Houston one of the most perfect systems of electric lighting they had ever seen.

A European journal relates that a few months since workmen employed upon some constructions on the bank of the river Dnieper, in Central Russia, employed the electric light to enable them to prosecute their labors at night. The brilliant rays of light attracted so many millions of nocturnal moths, beetles, and other insects, that from time to time it was necessary to stop work and set all hands to destroying the clouds of winged victims that frequently obscured the light. This suggested the idea of employing the electric light to destroy nocturnal insects prejudicial to agriculture, and experiments in that direction are to be tried. Not only to insects, but to fish, the light proved fatally attractive. Its rays, directed to the surface of the water, drew together vast quantities of all the fishes found in the Dneiper, and when within the charmed field of illumination they lay crowded together in masses, seemingly blinded and stupefied, the workmen, improving the opportunity, made a notable haul of fish.

ELECTRIC LIGHT NEWS

—— The electric light will be tried in the Evening High School of New York next winter, as being steadier and better than gas.

—— The electric light is a great boon to fruit growers near the cities in California. At Los Angeles, it is reported, several bushels of moths and millers are killed every night, while at Sacramento it is believed that the black beetle has been nearly exterminated.

—— Judge Shipman has just filed his decision in favor of the defendants in the suit of the Brush Electric Company against the United States Electric Lighting Company, which has been on trial nearly four years. The testimony covered 2,000 printed pages, and the oral argument occupied eight days. The suit was upon the two principal patents of Charles F. Brush, which, it was claimed, covered the entire business of electric arc lighting. One of the patents was withdrawn, and Judge Shipman decides the other to be invalid, and dismisses the libel, with costs as to both.

—— One of the beauties of the Philadelphia exhibition will be the great electric fountain, which, from a basin thirty feet across, and surrounded by banks of flowers, will throw up twelve jets of water, a skillfully devised arrangement forcing colored light along the curves of the falling streams, which, as they meet and break, will show the prismatic hues of the spectrum, while from the central column will rise three lofty jets like brilliant tropical flower sheaths. From time to time the lights in the vicinity are to be lowered to give full effect to this magnificent fountain with its varied colors.

—— The first electric light that has ever been tried in this country for lighthouse purposes is in use near Tompkinsville, Staten Island. It is situated in an iron tower, built for the purpose under the direction of Gen. J. C. Duane and Lieut. John Millis, who are experimenting on behalf of the Lighthouse Board to see whether it will be practicable to employ the electric light for the better protection of vessels approaching the coast. Better results will have to be reached than have been attained so far before it will be feasible to supplant oil with electricity in the general coast service. The great difficulty with the electric light in coast use is its tendency to flicker, and thus confuse the mariner.

—— While there are certain well-known dangers in connection with the system of lighting streets and buildings by electricity, there is an unfortunate disposition shown to exaggerate this danger. An instance of this kind was given a day or two ago, which well illustrates the readiness with which ignorance leads people to jump to false conclusions. Certain streets in South Boston are lighted by electricity, the company having in connection with its street service a telegraph line. Through some accident this telegraph wire was broken down so that a part of it fell upon the street. The report was instantly started that the electric light wire was broken, and people in the immediate vicinity considered that their lives were in danger. The fallen wire was as harmless as any piece of iron could be, and yet there were many willing to affirm that they received a severe shock from it. Indeed, from this slight accident any number of statements traveled abroad, and, no doubt, many who read or heard them were disposed to believe that the city government was guilty of gross neglect in permitting street travel to be in any way put in danger in this unnecessary manner. In reality, as we have said, no breakage of the electric wire occurred, and the shocks received were wholly shocks of the imagination, such as has been so frequently reported and exaggerated by the daily press in this city.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JULY 15, 1884.

301,872 Armature for dynamo-electric machines; Edgar A. Edwards, Cincinnati, assignor to Oscar M. Gollschall, trustee, Dayton, O.

301,888 Wire rope or cable; Milton W. Hazleton, Chicago, Ill.

302,061 Electric arc lamp; S. F. Van Choate, New York, N. Y.

302,062 Armature for dynamo-electric machines; S. F. Van Choate, New York, N. Y.

302,133 Incandescent electric lamp; George W. Hickman, Washington, D. C., and Joseph F. McCoy, Rahway, N. J., assignor to the Viaduct Manufacturing Company, Baltimore, Md.

302,134 Incandescent filament for electric lamps; George W. Hickman, Washington, D. C., and Joseph F. McCoy, Rahway, N. J., assignors to the Viaduct Manufacturing Company, Baltimore, Md.

302,175 Method of and means for generating currents for telegraphic purposes; Peter H. Vander Weyde, Brooklyn, N. Y.

302,176 Producing and utilizing induced currents; Peter H. Vander Weyde, Brooklyn, N. Y.

302,215 Electric temperature regulator; Charles A. Tucker, Islip, N. Y.

302,221 Regulator for electric arc lamps. Andrew Gray, Glasgow, county of Lanark, Scotland.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

The Ohio Paper Company, of Niles, Michigan, in a letter addressed to Mr. John R. Markle, manager of the Michigan Department for the Edison Electric Light Company, says: "It is now ten months since we began using the Edison Electric Light in our Paper Pulp Mills, no other light being provided, and, although handled by inexperienced men, we have not had to shut our mills down one night for want of light. Repairs on our machines five dollars will cover." This is certainly a gratifying exhibit.

The Palmer Wire Company is making hard drawn copper wire and is supplying the same in quantities. It is made from the best lake ingot, without alloy, and the company asserts that the tests to which it has been submitted prove it to be equal to any yet produced.

Electric Lighting at the International Health Exhibition.

Our esteemed contemporary London *Engineering* says, that one of the most striking features of the illumination of the Health Exhibition in London is the record which is presented of the extraordinary development during the last three years of incandescence illumination, as is illustrated by the immense number of incandescent lamps to be seen all over the exhibition. Hardly five years have elapsed since it was considered to be a practical and commercial impossibility so to subdivide the electric light as to have one or two hundred lamps worked upon a single circuit or by one machine, and to-day incandescent lamps may be seen at South Kensington in their thousands, and in one instance no less than a thousand lamps are being worked by one machine. When these interesting facts are compared, some idea may be formed of the service which scientific discovery gives to every-day requirements, and a very remarkable instance is furnished of the rapid development of a scientific experiment into a great commercial industry, when many minds are concentrated on producing that for which a public demand exists.

BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE Co., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire, Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN INSULATOR COMPANY, New York. Insulators of all sizes.

AMERICAN SPIRAL TELEPHONE WIRE Co., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York The Baxter Lamp.

A. M. YOUNG, Waterbury, Conn., Leclanche Zincs. Old style of rod with new connection.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON Co., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC Co., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER HARD RUBBER COMPANY, New York. Rubber Insulators and Electrical Supplies of every description.

C. H. MOORE & Co., Washington, D. C. Solicitors of American and Foreign Patents.

C. P. WHITNEY, New York. General Eastern Agent of the Detroit Iron Tower Company. Towers and Arches, for Park and Street Lighting.

CHARLES WILLIAMS, JR., Boston, Mass. Call Bells, Electric Bells, District Bells, Switch Boards, Annunciators, &c., &c. Write for quotations.

CHROME STEEL WORKS, Brooklyn, N. Y. Steel for Magnets a specialty; Chrome Cast Steel.

COE BRASS Co., Torrington, Conn. Brass, Copper and German Silver in every variety of Sheets, Rolls, Plates, Wire, Rods and Blanks or Shells. Pure Lake Superior Copper Wire and Battery Zincs. Write for price list.

CONNOLLY BROTHERS, New York, Patent Attorneys and Solicitors.

CORNELL UNIVERSITY, Ithaca, N. Y. Electrical Engineering.

DETROIT ELECTRIC COMPANY, Detroit, Mich., white oak Pins and Brackets.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

F. E. KINSMAN & Co., New York. Imported and Experimental Apparatus, Geisler Tubes, Motors, Coils, Lanterns, etc.

HARVEY, STAFFORD & Co., Acton, Ont., Canada Telegraph and Telephone Poles.

H. M. RAYNOR, New York. Platinum for all purposes.

HOLMES, BOOTH & HAYDENS, New York. Fireproof Electric Light Wire, Patent "KK" Insulated Copper and Iron Wire for Telephone and Telegraph use. Send for catalogue and prices.

I. W. COLBURN & Co., Fitchburg, Mass. Dynamo Electric Machines.

J. O. SHIRAS, Cincinnati, O. Telephone Stocks bought and sold.

JARVIS ENGINEERING COMPANY, Boston, Mass. Boilers set with the Jarvis Patent Furnace.

LECLANCHE BATTERY COMPANY, New York. The Great Telephone Battery. Write for description and prices.

J. H. BUNNELL & Co., New York. The Morse Learner's Instrument, Telegraph Instruments of all kinds, Telephone and Telegraph Supplies. Illustrated Works on Electrical Measurement, and the Galvanometer and its uses. Send for catalogue.

LAW TELEGRAPH Co., New York. The Law Battery for Telephone and Telegraph purposes.

MITCHELL, VANCE & Co., New York, manufacturers of Electroliers and Combination Fixtures, for both gas and electric light.

MONARCH ELECTRIC COMPANY, New York. Electric Motors, Dynamo Machines, etc.

NATIONAL ELECTRIC COMPANY, Washington, D. C. Electrical supplies and apparatus.

NEW ENGLAND BUTT COMPANY, Providence, R. I. Braiding Machinery for covering Telegraph, Telephone and Electric Light Wire, Single and Double Winders and Braiders of every description; also Fine Castings. Send for catalogue.

O. W. MADDAUS, New York. Designer and Engraver.

PAINE & LADD, Washington, D. C. Attorneys in Patent Causes, and Solicitors of Patents.

PALMER WIRE Co., Palmer, Mass., and New York. Galvanized Telephone and Telegraph Wire Iron and Steel Wire of best quality, Material, finish and conductivity. Write for quotations.

PARTRICK & CARTER, Philadelphia, Pa. Electric Annunciators, Learners' Instruments, Batteries and Telegraph and Telephone Supplies. Write for circulars.

PHOSPHOR BRONZE SMELTING Co., Philadelphia, Pa. Telephone Wire, insulated and bare.

ROYCE & MAREAN, Washington, D. C. Dealers in Electrical apparatus, Telegraph and Telephone supplies.

RHODE ISLAND TELEPHONE & ELECTRIC Co., Providence, R. I. Manufacturers of the Providence Telephone Switch Boards, Breckenridge Jacks, Wright Cable Clips, Howard Safety Appliances, &c.

SCHLEICHER, SCHUMM & Co., Philadelphia, Pa. Manufacturers of the Otto Gas Engine. Write for catalogue.

THE FREEMAN & ROE ELECTRICAL SUPPLY COMPANY, New York. Electric Light Machines, Motors, Dynamos, Telegraph and Telephone Apparatus.

SWAN INCANDESCENT ELECTRIC LIGHT Co., New York. Incandescent Lights, and Complete Apparatus. Send for illustrated catalogue.

THE ANSONIA BRASS AND COPPER Co., New York Pure Electric Copper Wire for Magnets, Telephone Lines, and Electric Light purposes, Office Wire, Zinc Rods and Battery Copper.

THE BISHOP GUTTA PERCHA WORKS, New York, Gutta Percha Insulated Submarine Telegraph Cable Subterranean Telegraph Cables, Aerial Telegraph Cables, Lead or Hempen covered Torpedo Cables, Lead-covered Cables, Telephone Cables of all kinds —G. P. Office Wire, and Marks' Compound Insulated Wire, &c., &c. Send for catalogue.

THE BUTLER HARD RUBBER COMPANY, New York. Electrical supplies, Rubber Hook Insulators, Hardwood Tubes, Plug Handles, Lamp Switch Handles, Battery Syringes, etc.

T. H. ALEXANDER, Washington, D. C., Solicitor and Counselor in Patent cases.

THOMSON-HOUSTON ELECTRIC Co., Boston, Mass. Automatic Self-regulating System of Arc Lighting.

THE ELECTRICAL SUPPLY Co., New York. Electric Light, Telephone and Telegraph Supplies. Send for price list and catalogue

TRENTON IRON Co., Trenton, New Jersey. Galvanized Iron and Steel Wire of all kinds for Telephone and Telegraph purposes. Write for prices.

UNITED STATES ELECTRIC LIGHT Co., New York. Arc and Incandescent Lights, complete and reliable systems, &c. Write for information.

VIADUCT MANUFACTURING COMPANY, Baltimore, Md. Electrical Goods of every description. Electric Light and American District supplies. Send for price-list.

VICTOR, BISHOP & Co., New York. Platinum for all Manufacturing, Chemical and Electrical purposes. Send for prices.

WESTERN ELECTRIC Co., New York, Boston, and Chicago. Telegraph and Telephone Apparatus and Supplies of every description. Send for catalogue.

WM. A. HARRIS, Providence, R. I. The Harris-Corliss Steam Engines and Light and Heavy Castings.

W. R. POPE & Co., Baltimore, Md. Telegraph, Telephone, and Electric Light supplies. The best of everything, and at lowest prices.

WILLIAM KLINE, Toledo, O. Patent Portable and Adjustable Cross-Arm Holder.

Average Market Quotations of Battery Supplies for the Week Ending July 19th, 1884.

Leclanche Disque Cell, complete	$1.25
" Prism " "	$1.67
" Prisms, per pair	$1.00
" Carbon Mounted	30c.
" Jar Cover	12c
" Sal Ammoniac, in bag	8c
" Porous Cell	$1.10
" Glass Jar	18c.
" Amalgamated Zinc	10c.
" Rubber Bands, per pair	6c.
Chlorine Battery, per cell	$1.25
Law Battery, per cell	$1.25
" Jar and its Rubber Ring	25c
" Cover, with small Carbon sealed in	35c.
" Large Carbons, each	20c.
" Carbon Connector	12c.
" Zinc Connector	8c.
" Rubber Bolt	12c.
" Zinc and its Rubber Ring	12c.
Bergman & Haid, per cell	$1.20
Crow foot, 6x8, per cell	75c.
Callaud Zincs	30c.
" Coppers	15c.
" Jars	25c.
Sal Ammoniac, per lb	15c
Blue vitriol, per lb	10c.
" " bbl., lots, per lb	5½c.
Sulphate of zinc	10c.
Battery syringe	$1.90c.
Battery brush	20c.
Hydrometer	50c.

Send to our advertisers for price lists.

Neatly-bound volumes (half-yearly) of the ELECTRICAL REVIEW will be sent, postage prepaid, on receipt of $3; also the latest improved self-binders for the ELECTRICAL REVIEW, or any other electrical or scientific journal published in this country, for $1. Delano & Company, publishers, 23 Park Row, New York, N. Y.

Any of our readers having copies of the old REVIEW of the TELEGRAPH AND TELEPHONE, dated March 15th, 1882 (No. 3), not specially needed by them, will confer a great favor upon us by sending them to this office, for which we will remit twenty-five cents per copy. DELANO & COMPANY, 23 Park Row, New York.

Box 3,329.

JUST OUT.
Electricity, Magnetism
AND
Electric Telegraphy.
A Practical Guide for Students, Operators and Inspectors,
BY
THOMAS D. LOCKWOOD,
PRICE, $2.50
379 PAGES, WITH 150 ILLUSTRATIONS.
D. VAN NOSTRAND, Publisher,
23 Murray and 27 Warren Sts., N. Y.
Complete Catalogue of Electrical Works will be sent to any address on application.

WANTED.
Position wanted by an Electrical Engineer, long experienced in Electric Lighting and Manufacturing Electric Light Apparatus. Address B, Care of Electrical Review, New York.

Electric Lighting
The MASSACHUSETTS CHARITABLE MECHANICS ASSOCIATION will receive PROPOSALS for LIGHTING their EXHIBITION BUILDING by 100 or more arc lights during the Fiftieth Exhibition, September and October next. They reserve the right to reject any proposals.
Apply in person or address
A. H. BERRY,
Superintendent,
MECHANICS' BUILDING,
Huntington Avenue, Boston, Mass.

Additional Features of the Franklin Institute Display.

Not the least interesting part of the Electrical Exhibition, says the *Engineer*, will be that which is to involve the illumination by electricity of the Holman lantern microscope. This instrument, which is of the highest use in public lectures, and in presenting to entire audiences magnified objects that without it could never have been projected upon a screen, has hitherto been illumined only by the lime light. Now, however, it is undergoing alteration with a view to employing electricity as the illuminating agent. The objection to this heretofore has been the unsteadiness of the light owing to the liability of the current to interruption.

A number of electric lamps have already been offered, in which the inventors believe that they have overcome this difficulty, and to each a fair trial will be accorded, if the purpose of having attractive illustrated lectures delivered during the progress of the exhibition is carried out, as it now seems likely to be.

Among the latest invoices received by the committee is a valuable numismatic contribution from the British Museum, consisting of electrotype fac similes of rare Greek and Roman coins, the originals of which are kept under lock and key instead of being placed on show even in the institution itself, their places being filled by copies like those transmitted to this country.

Another application has been received, this time from a French inventor, for space for an instrument to transmit photographic images by electricity through the variable conductivity of selenium, as in the apparatus described in these columns a few days since, as invented by a New York electrician. The instrument is called the telectroscope. Prof. Houston states that the discovery of this important property in selenium, namely, its variable conductivity under sunlight, was made in May, 1872, and was communicated to the Society of Telegraph Engineers on the 17th of February, 1873. Prof. Willoughby Smith, who made the discovery, stumbled over it, as often happens in the course of scientific investigation. He was experimenting with a view to cable tests, and was considerably puzzled by the extremely variable results, so much so, indeed, that he went to work to find out the cause, and was rewarded by ascertaining that selenium offered less electrical resistance when exposed to sunlight than when in the dark.

He exhibited to the telegraph engineers an apparatus in which platinum wires were inserted into the opposite ends of a selenium bar, hermetically sealed in a glass tube. Placed in a dark box and connected with an electrometer, it was found that opening the box caused an instantaneous reduction in the resistance, and the apparatus was found to be so sensitive that it was affected by merely interposing the hand between the selenium bar and the light of a distant gas burner. Prof. Adams, of Kings College, showed that the greenish yellow rays were most effective in varying the resistance, and Prof. Siemens produced a variety the conductivity of which was fifteen times greater in the light than in darkness.

THE BUTLER HARD RUBBER CO.,
33 MERCER STREET, NEW YORK,
Manufacturers of
HARD RUBBER,
Sheets, Rods, Tubing, etc.,
ELECTRICAL SUPPLIES
Rubber Hook Insulators,
Window Tubes with Heads,
Key Knobs, Switch Handles,
Plug Handles, Lamp Switch Handles,
Battery Syringes, etc., etc.
Specialties of any PRACTICABLE CHARACTER made to order.

MITCHELL, VANCE & CO.,
GAS FIXTURE MANUFACTURERS,
Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application.
836 & 838 BROADWAY,
NEW YORK.

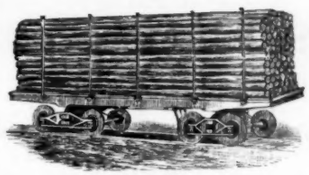
WHITE OAK PINS AND BRACKETS,
Of Our Own Manufacture.
Correspondence and Inspection solicited.
DETROIT ELECTRICAL CO.
Cor. Seventh & Woodbridge Sts.,
DETROIT. MICH.

LAURENCE & HERKNER,
Manufacturers of
Leather Belting
—FOR—
ELECTRIC LIGHTING.
Pure Oak Tanned.
Factory and Salesroom,
8 FERRY STREET, NEW YORK.
☞ Estimates made and full particulars furnished on application as above, personally or by mail.

THE BRUSH ELECTRIC Co., CLEVELAND, OHIO.
The Sole Manufacturers under all the Patents of CHAS. F. BRUSH for
ELECTRIC LIGHTING, STORAGE BATTERIES, ETC.
We furnish the only complete and PERFECT SYSTEM of electric lighting.
THE BEST DYNAMO MACHINES.
THE BEST ARC LAMPS.
The Only Practical Storage Batteries.
The Purest and Best Carbons, &c.
Our prices are the lowest, our factory the largest and our business the most extensive in the world to-day.
Price, Single Lamps $50.00, Double Lamps $60.00.
SEND FOR DETAILS.
THE BRUSH ELECTRIC CO.,
No. 104 EUCLID AVE., CLEVELAND, OHIO.

Electric Light Machines.
STANDARD SIZES.

No. of Mch.	No. of Lights 2,000 c. p.	No. of Lights 1,200 c. p.	Horse Power Required	Price.
2	1		1½	$300.00
2		2	1½	300.00
3	2		3	415.00
3		3	3	415.00
4	4		4	565.00
4		6	4	565.00
5	10		8	900.00
5		15	8	900.00
6	20		14	1,500 00
6		30	14	1,500.00
7	30		22	2,000.00
7		45	22	2,000.00
8	65		45	3,600.00



RED CEDAR POLES,
THE MOST DURABLE IN USE.
For Prices and Estimates apply to
W. B. EARTHMAN & CO.
MURFREESBORO,
Rutherford Co., Tenn.

THE CLARK INSULATED ELECTRIC WIRE COMPANY,
LIMITED.
Rubber and Braided Wire.
BRAIDED OR ARMORED CABLES
of every descripton for
Telegraph, Telephone, Electric Light and Signal Work.
Send for Prices.
J. CHESTER WILSON, Gen'l Manager.
419 WALNUT ST., PHILADELPHIA.

INCANDESCENT LIGHTS
SWAN INCANDESCENT ELECTRIC LIGHT CO.
OWNERS OF THE
SWAN PATENTS FOR THE UNITED STATES,
ARE PREPARED TO GRANT LICENSES TO COMPANIES TO SELL AND USE THE SWAN INCANDESCENT LAMP, INCLUDING OUR PATENTED HOLDERS, SWITCHES, CUT-OFFS, ETC. WE GUARANTEE OUR LAMP AND TO DEFEND THE VALIDITY OF OUR PATENTS. FOR TERMS OR INFORMATION, APPLY TO
THE SWAN INCANDESCENT ELECTRIC LIGHT CO.,
853 Broadway, Cor. 14th Street, New York

MANUFACTURER OF SUPERIOR
Carbon Points
$15. $15. $15.
Plates
BUFFALO ELECTRIC WORKS
A splendid carbon for summer lighting that will last from 6 to 8 hours, for $15.00 a thousand. Write to us for prices and samples, giving the system used, before making any contract for carbons at any price.
1590 to 1620 Niagara Street,
BUFFALO, N. Y.

CONNOLLY BROS.,
Patent Attorneys
AND SOLICITORS,
MORSE BUILDING,
Cor. Nassau & Beekman Streets,
NEW YORK.
PHILADELPHIA, PA.,
Mutual Life Insurance Building,
10th AND CHESTNUT STREETS.
WASHINGTON, D. C.
CORNER 6th and F STREETS.
ELECTRICAL CASES A SPECIALTY.

Telephone Stocks
BOUGHT AND SOLD BY
J. O. SHIRAS, No. 11 West Third St., Cincinnati, O.

T. H. ALEXANDER,
Solicitor and Counsellor in Patent Cases,
607 7th St., Washington, D. C.,
OPPOSITE PATENT OFFICE.
Twenty-three Years' Practice.
Expert examinations and opinions, relating to Infringements, Validity and Scope of Patents, Caveats, Designs, Trade-Marks, European and Canadian Patents. For information on Patent matters, send stamp for my "HINTS TO INVENTORS."

PAINE & LADD,
ALBERT E. PAINE, Late Commissioner of Patents. STORY B. LADD.
Attorneys in Patent Causes
And Solicitors of Patents,
WASHINGTON, D.C.

Bargains in IMPORTED scientific and Experimental Apparatus, GEISLER TUBES, MOTORS, COILS, LANTERNS, &c., &c., Carbons for all kinds of Electric Light.
F. E. KINSMAN & CO.
145 Broadway, - New York.

THE MILITARY TELEGRAPH
DURING THE CIVIL WAR.
BY WILLIAM R. PLUM, LL.B.
Two Volumes, Cloth, Illustrated, $5.00
DELANO & COMPANY, Publishers,
No. 23 PARK ROW,
P. O. Box 3329. NEW YORK.

The Fiske & Mott High Resistance Insulator.

"Regular" (20 oz.)

We refer without permission to
The Baltimore and Ohio Telegraph Co.
The Bankers and Merchants' Telegraph Co.
The Chicago and Milwaukee Telegraph Co.
The N. W. Overland Telegraph and Telephone Co.
Brush Electric Light Co., in all the principal cities, including Cleveland, Detroit, Pittsburgh, &c.

Practical tests, in actual use, of those INSULATORS, since their introduction in February last, warrant us in guaranteeing for them a superiority of insulation, of from 100 to 300 per cent. over all others, and has demonstrated the correctness of the principle involved in their construction, viz., that of attacking the evil of leakage at its root—by PREVENTING THE ESCAPE OF THE CURRENT FROM THE WIRE to the insulator—and thus rendering unnecessary all appliances aiming to lessen the leakage FROM THE INSULATOR to its supporting pin.
While they are the most EFFICIENT, they are at the same time the STRONGEST, best made, and all things considered, the cheapest glass INSULATOR in the market. They are now in use by Telegraph, Telephone and Electric Light Companies in all parts of the country and must eventually supersede all others where high insulation is required.
Price of "Regular" 6 cents, and of "Pony" 3 cents, f. o. b. at Chicago, Detroit, New York, Philadelphia, or Baltimore—with special discounts on large orders.
In our Patent Screwknob—the Screw is cast solid in the knob, and in addition to their convenience in putting up, are superior in insulation, when wet, to either glass or porcelain.
Our Combination Hook is made with or without cup. It contains no rubber, and will not deteriorate by exposure to the weather. Price of Knobs, No. 5 A. (2 inches,) $4.50 per hundred; Price of Knobs, No. 6 A. (1.5 inches,) $3.00 per hundred; Price of Combination Hook, $10.00, all f. o. b. at Chicago—with liberal trade discount.

No. 6 A. Knob (actual size.)

"Pony" (11 oz.)

The Wisconsin Telephone Co.
Edison Electric Light Cos., at New York, Chicago, and elsewhere.
The Fire Alarm Tel. Departments of the cities of Chicago, Cleveland, &c.
Also to
Geo. A. Hamilton, Electrician, Western Union Telegraph Co.
Stephen D. Field, Electrician, Commercial Telegram Co.

Samples of any of our goods sent on application. Correspondence invited.
THE CHICAGO INSULATING COMPANY, No. 122 LA SALLE ST., CHICAGO, ILLINOIS.

BOULTON CARBONS

These carbons are made of the
BEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch in diameter, varying by sixteenths.
Special LENGHTS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.

BOULTON CARBON WORKS,
PAYNE AVENUE,
CLEVELAND, O.

SPENCERIAN INK
Extra Black, Blue Black, and Copying, all of superior quality, claiming Special excellence in the essentials of Fluidity, Color and Durability. Circulars free.
Ivison, Blakeman, Taylor & Co., N. Y.

Leclanché Zincs.
PATENT
SPRING CONNECTION.
ZINC RODS
of all descriptions will be supplied the trade at lowest rates.
A. M. YOUNG,
Waterbury, Conn.

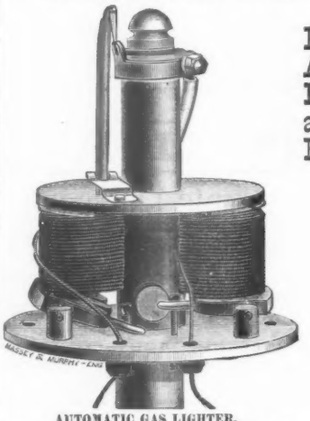
ИЛЛЮСТРИРОВАННЫЕ КАТАЛОГИ
EXECUTED
IN FIRST CLASS STYLE AND WITH DESPATCH
O.W. MADDAUS
DESIGNER AND ENGRAVER ON WOOD
PARK ROW NEW YORK

THE
NATIONAL LETTER CABINET FILE,
Patented and Manufactured by
O. C. MACKENZIE,
Successor to CULVER, PAGE, HOYNE & CO.,
186 and 188 Fifth Avenue, - Chicago.
320 and 322 Broadway, - New York.
SEND FOR ILLUSTRATED CATALOGUE.
TESTIMONIALS.
We are much pleased with your letter file and can recommend it as a very useful article.
SEMON, BACHE & CO., NEW YORK.
We do not hesitate to say it is *the best Cabinet Letter File made*, and can recommend the same to any and all business houses. It is the "boss."
GEO. D. BARNARD & CO., ST. LOUIS, MO.

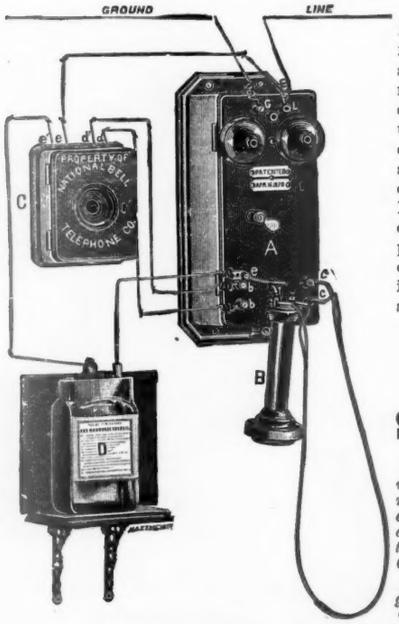
HUGO KAYSER,
Manufacturer of
Electrical Instruments
AND
LIGHT MACHINERY.
EXPERIMENTAL WORK and MODELS
A SPECIALTY.
12 ELM STREET, NEW YORK,
Bet. Duane and Reade Streets.

H. M. RAYNOR,
No. 25 Bond Street,
New York.
ESTABLISHED 1859.
PLATINUM
IN
All Forms
FOR
ALL PURPOSES,
Wholesale and Retail

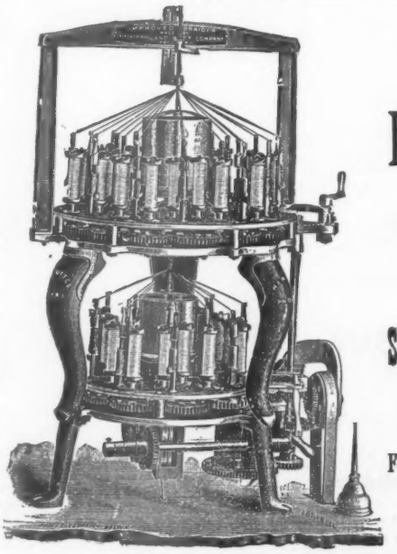
THE THOMSON-HOUSTON ELECTRIC CO.
Principal Office, 131 Devonshire St., Boston, Mass.,
FURNISHES THE
ONLY PERFECT AUTOMATIC, SELF-REGULATING SYSTEM OF ELECTRIC ARC-LIGHTING IN THE WORLD.
In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical*, *efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.
THE THOMSON-HOUSTON ELECTRIC CO. was awarded the FIRST PRIZE for the *best system* of arc lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.
The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

BOSTON ELECTRIC CO.,
550 WASHINGTON ST., BOSTON, MASS.,
MANUFACTURERS OF
Electrical Apparatus, Hotel Annunciators, Electric Bells, Burglar Alarms, Electric Light and Telephone Supplies, and Electric Gas Lighting Devices.

AUTOMATIC GAS LIGHTER.
Practical in every particular and perfectly reliable.

IMPROVED
CIRCULAR BASE BELL
Price, $1.75.

THE
American Bell Telephone Co.
WM. H. FORBES, *President.* THEO. N. VAIL, *Gen'l Manager.* WM. R. DRIVER, *Treasurer.*


This Company owns the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents, covering improvements upon the same, and controls, except for certain limited territory, under an arrangement with the Western Union Telegraph Co., the Gold and Stock Telegraph Co., the American Speaking Telephone Co., and the Harmonic Telegraph Co., the Patents owned by those Companies, and is prepared to furnish telephones to the citizens of the United States through its local Licensees, on the following systems:
EXCHANGE,
PRIVATE LINE, &
SPEAKING TUBE LINES
Those desiring instruments on Private or Speaking Tube Lines, or connections on Exchanges, will please apply to the nearest Licensed Exchange, when their case will be brought to the attention of the proper local Company.
Any further information will be gladly furnished on application to the Company at its office,
No. 95 MILK STREET, BOSTON, MASS.
All persons using telephones not licensed by this Company, are hereby respectfully notified, that they are liable to prosecution, and for damages for infringement, and will be prosecuted according to the full extent of the law.

NEW ENGLAND BUTT CO.
PROVIDENCE, R. I.
MANUFACTURERS OF

BRAIDING MACHINERY
FOR COVERING
Telegraph, Telephone and Electric Light Wire
ALSO
SINGLE AND DOUBLE WINDERS
AND
Braiders of every description,
For Silk, Worsted and Cotton Braid.
FINE CASTINGS
A SPECIALTY.

The Coe Brass Mfg. Co.

MANUFACTURERS OF

BRASS,

Copper & German Silver,

IN EVERY VARIETY OF

SHEETS, ROLLS, PLATES, WIRE, RODS & BLANKS OR SHELLS,

Pure Lake Superior Copper Wire

A SPECIALTY,

BATTERY ZINCS.

TORRINGTON, Litchfield Co., CONN., U. S. A.

THE PAYNE

Single and Double Valve Automatic Engine.

Will guarantee 20 per cent. better regulation with our *single slide valve automatic engine* than can be attained by any other engine in the market. For sale by E. P. Hampon & Co., 36 Cortlandt St., N.Y., Hill, Clark & Co., Boston, Mass. Write for Circular No. 36. B.W. Payne & Sons. Box 1450, Corning, N.Y.

MAGNET STEEL

AND ALL KINDS OF

CHROME CAST STEEL.

STEEL for MAGNETS

A SPECIALTY,

And warranted superior to all other brands.

CHROME STEEL WORKS,

Brooklyn, E. D., N. Y.

S. H. KOHN, *Proprietor.* C. P. HAUGHIAN, *Superintendent.*

CHARLES WILLIAMS, JR.

[Established 1856.]

Nos. 109-115 COURT ST., BOSTON, MASS.

—AUTHORIZED MANUFACTURER OF—

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button

CALL BELLS,

ELECTRIC BELLS,

DISTRICT BELLS

AND

Switches for Exchanges Annunciators, &c.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every description.

JARVIS ENGINEERING CO.,

BOSTON.

Boilers Set with the Jarvis Patent Furnace to burn Pea Coal, Screenings or Slack without a blower. Send for Circulars.

The Buckeye Automatic Cut-Off Engine

Trade Circulars and practical treatise on Steam Engineering free by mail.

CONTRACTS PROMPTLY EXECUTED.

These engines are carefully constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable economy in consumption of steam, and superior regulation guaranteed.

Address, BUCKEYE ENGINE CO., Salem, Ohio; or GEO. A. BARNARD, Eastern Sales Agent, Astor House, N. Y. D. L. DAVIS, Sales Agent, 23 S. Canal Street, Chicago, Ill.

PATENT PORTABLE & ADJUSTABLE

CROSS ARM HOLDER.

No more weakening of poles by cutting gains or mortising. Can be attached to any pole and changed when desired. Hundreds of these Holders now in use.

Recommended by practicable line builders. For information and circulars, apply to

WM. KLINE, Supt. Teleg., TOLEDO, O.

DETROIT IRON TOWER CO.

Towers AND Arches

FOR PARK AND STREET LIGHTING.

The sure means by which Illuminating is done better and cheaper than by gas.

One tower will supersede several hundred gas lights, by the use of three to six 2000 candle power lights at 125 to 175 feet high. Of the many in use, not one has failed to give satisfaction, nor have they been injured by the fiercest storms. They are of many styles and highly ornamental as well as cheap.

C. P. WHITNEY, GENERAL Eastern Agent.

853 BROADWAY, N. Y.

J. W. COLBURN & Co. MFG'S OF Dynamo-Electric Machines ESTABLISHED Fitchburg, Mass. SEND FOR CATALOGUE

VICTOR BISHOP & CO.,

IMPORTERS OF DIAMONDS,

PLATINUM

For all Manufacturing, Chemical, Electrical, Dental, and Laboratory purposes.

Victor Bishop & Co.,

ESTABLISHED 1837. No. 33 MAIDEN LANE, NEW YORK.

1884.

CULMINATION OF THE SERIES!

12TH

CINCINNATI

INDUSTRIAL

EXPOSITION

Opens Sept. 3rd—Closes Oct. 4th.

A WONDERFUL DISPLAY OF

Manufactures-Arts-Inventions-Products

OPEN TO THE

COMPETITION OF THE WORLD.

Admission 25 Cents.

Exhibitors from every State in the Union and Foreign Countries.

No charge for space or steam power. Special arrangements made for transportation of exhibits and visitors. For full particulars, address, J. F. WALTON, Sec'y.

1884.

ESTABLISHED 1864.

WILLIAM A. HARRIS

MANUFACTURER OF

HARRIS-CORLISS

STEAM ENGINES

With Harris' Patented Improvements

ALSO

Light and Heavy Iron Castings

PROVIDENCE, R. I.

Send for copy "Engineers' and Steam Users' Manual," by John W. Hill, M. E. Price, $1.25.

"OTTO" GAS ENGINE

OVER 10,000 IN USE.

Started Instantly by a Match. When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.

Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 Ind. H. P.

SCHLEICHER, SCHUMM & CO.

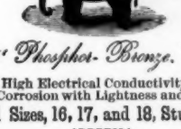
N. E. cor. 33d & Walnut, Phila.

Branch Office: 214 Randolph Street, Chicago.

PHOSPHOR-BRONZE

TELEPHONE WIRE,

Insulated and Bare.



"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS;

The Phosphor-Bronze Smelting Co. (limited,)

512 ARCH ST., PHILADELPHIA, PA.

Owners - of - the - United - States - Phosphor-Bronze - Patents.

Sole Manufacturers of Phosphor-Bronze in the United States.

J. H. LONGSTREET,

No. 9 Barclay Street, New York,

Manufacturer and Dealer in

TELEGRAPH INSTRUMENTS,

Telephone and Telegraph Supplies

—OF EVERY DESCRIPTION.—

ANNUNCIATORS AND BURGLAR ALARM APPARATUS, BATTERIES AND BATTERY MATERIAL.

Telegraph Instruments for Railroad Use a Specialty.

A NEW AND SUBSTANTIAL

BUSINESS INDUSTRY.

Large Profits to First-class Business Men.

The Thomson-Houston Arc and Incandescent System of Electric Lighting is universally acknowledged to be the most perfect and economical ever invented.

Local Companies cannot afford to use any other.

Companies now using this system are making large profits on their investments.

Complete Central Lighting Stations for City and Commercial Lighting, with Boilers, Injectors, Heaters, Armington & Sims' high-speed Engines and Wire lines, will be contracted for and constructed by the American Electric and Illuminating Co., 197 Congress Street, Boston, Mass., in any city or town in the United States where exclusive territory has not already been ceded.

To active and responsible business men, who can command a portion of the necessary capital to build central stations and secure business for same, this Company will furnish the remaining capital upon liberal terms. Address

EDWARD H. GOFF, President.

PARTRICK & CARTER,

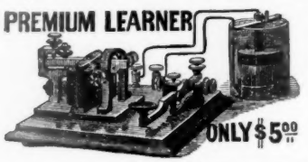
Philadelphia, Pa.,

MANUFACTURERS OF

Telephone, Telegraph

And Electrical Instruments and Supplies.

Among our SPECIALTIES are the CELEBRATED



Not the Cheapest, but GUARANTEED THE BEST.

COMPLETE OUTFIT ONLY $5.00.

The Fitch Chlorine Battery, patented Sept 16, 1879, acknowledged the **Best** Battery in use for Telephones, Annunciators, Call Bells, etc. Price, $1.50 per cell. Liberal discount to the trade.

The Acme Steel Lever Key, best and most perfect Key ever placed before the telegraphic profession; endorsed by hundreds of the most expert telegraphers in the country. Price by mail, $3.00.

The **Original Giant Sounder,** price $4.00 by mail. Send for our catalogues and price lists. Correspondence solicited.

PARTRICK & CARTER,

Telephone, Telegraph & Electrical Instruments and Supplies of every description,

114 SOUTH 2d ST., PHILADELPHIA, PA.

American Electrical Works

MANUFACTURERS OF

Patent Finished Insulated

Electric Wires,

TELEPHONE AND ELECTRIC CORDAGE,

ELECTRIC LIGHT WIRE

MAGNET WIRE,

PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.

OFFICE AND FACTORY:

No. 67 STEWART STREET,

PROVIDENCE, R. I.

EUGENE F. PHILLIPS, President.

W. H. SAWYER, Secretary and Electrician.

SPIRAL

TELEPHONE

WIRE.

For Long & Short Distance Telephoning

Patents allowed April 24, July 25, 1883.

American Spiral

Telephone Wire Company,

43 Milk Street,

BOSTON, MASS.

THE

Law Battery.

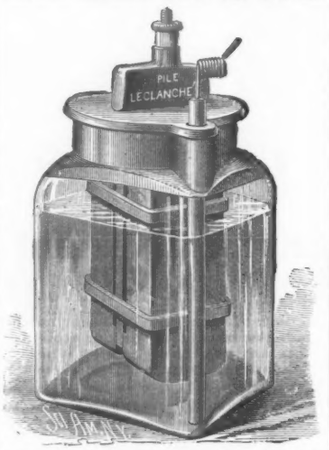
The BEST Open Circuit Battery in the World and the CHEAPEST.

Combines all the advantages of the best of the others, without any of their disadvantages. Thousands sold monthly. Send for circular. Manufactured and sold by the

LAW TELEGRAPH CO.,

140 Fulton St., New York.

LECLANCHE



Prism Battery, Complete. Size of Jar, 6x4½ inches.

THE GREAT

TELEPHONE BATTERY.

The Standard Open Circuit Battery of the World.

OVER 500,000 CELLS NOW IN USE IN THE UNITED STATES AND 1,000,000 IN EUROPE.

ADOPTED BY ALL THE

Telephone Companies.

THE SIMPLEST, CLEANEST, MOST DURABLE, MOST ECONOMICAL.

Beware of Infringements and Cheap Imitations.

LECLANCHÉ BATTERY CO.

149 W. 18th St., N. Y., or

L. C. TILLOTSON & CO., 5 & 7 Dey St., N. Y.

THE BERGMANN & HAID BATTERY.

The Greatest Open Circuit Battery in the World.

Superior to the Leclanche and all others, for Telephone, Annunciator, Burglar Alarm, and all open circuit work.

Price (complete) $1.20.

Liberal discount to dealers.

Send for descriptive Circular and Price List.

Pat'd {Oct. 16, 1883. Nov. 20, 1883.

BERGMANN & CO.

Electrical Works,

292, 294, 296 & 298 AVENUE B,

NEW YORK, N. Y.

CORNELL UNIVERSITY.

COURSES IN

Electrical Engineering, Mechanical Engineering, Civil Engineering, and Architecture.

Entrance Examinations Begin at 9 A.M., June 16 and Sept. 16, 1884.

For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE TREASURER OF CORNELL UNIVERSITY, Ithaca, N. Y.

C. H. MOORE & CO.,

SOLICITORS OF

American and Foreign Patents,

ELECTRICAL APPLIANCES A SPECIALTY.

Interferences, Appeals, and all business before the office and the courts given prompt attention. Address Lock Box 490, Washington, D. C.

NOW READY.

Electrical Measurement AND The Galvanometer and Its Uses.

BY T. D. LOCKWOOD.

144 pages, handsomely bound, large clear type, and fully illustrated with diagrams of connections, engravings of apparatus, etc. Price, $1.50. Sent by mail, Postpaid, to any Address upon receipt of price.

Every Telegraph Office Manager, or Telegraph Operator, every Telephone Central or District Telegraph Manager, every Student of Electrical Science, every person having charge of Electric Light Plant, or other Electrical Arrangements and Apparatus, and every person who takes an interest in Electrical Matters of any kind, should read

T. D. LOCKWOOD'S

"Electrical Measurement and the Galvanometer."

It is the only book which EXPLAINS in PLAIN ENGLISH and without algebraic formulae all about Electric Measurement and the Use of Galvanometers, besides giving fully detailed and illustrated description of

GALVANOMETERS & RHEOSTATS,

with all diagrams of connections required in using them, and the plain and simple reason why for everything.

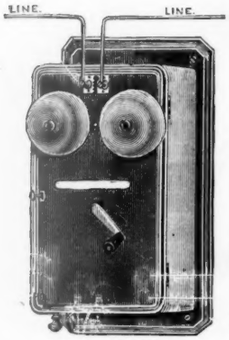
In this remarkable book the whole subject of Electrical Measurement is made so clear and plain that ANY ONE can easily understand every explanation, and can practically make electrical measurements without difficulty, and especially without "doing" sums in algebra.

PUBLISHED BY

J. K. BUNNELL & CO.

212 Liberty Street, New York,

TO WHOM ALL ORDERS SHOULD BE SENT



Viaduct Manufacturing Co.

OF BALTIMORE.

(Successors to late firm of DAVIS & WATTS.)

A. G. DAVIS, President.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

Telephone, Telegraph, Electric Light and American District Supplies.

SEND FOR ILLUSTRATED CATALOGUE,

MAGNETO SIGNAL BELLS.

NO BATTERY REQUIRED.

$4, to $6, each. Discount on large lots.

THE ELECTRIC

STORAGE AND LIGHT CO.

95 Milk St., Boston, Mass.

Organized under the Laws of Massachusetts,

OWN THE PATENTS FOR

Faure's Storage Batteries,

OR

Electrical Energy Accumulators,

FOR

MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT

WANTED.

A first-class man wants situation with Telephone Co., fifteen years electrical experience including five years in Telephone, Inventor of new telephone and exchange system. PRACTICAL, Care of Electrical Review.

WANTED.

An Electrician who understands the business wants a position with Electric Light Company. Excellent references. Address, ELECTRICIAN, Care Electrical Review, N. Y.

THE FREEMAN & ROE ELECTRICAL SUPPLY CO.,

53 Broadway, N. Y.

DEALERS IN

Electric Motors, Dynamos and Electric Light Machines,

TELEGRAPH and TELEPHONE APPLIANCES

OF EVERY DESCRIPTION,

Learners Instruments & Alarms

Sole Agents for

The "Excelsior" Electric Call Bell, - $1.75

The "Toy" Telephone, 1.00

The Freeman & Roe Hotel Annunciator.

Furnish Estimates for and promptly execute all Electric Work for Architects, etc. Send for Circulars. Correspondence solicited.

THE TRENTON IRON CO.,

MANUFACTURERS OF

Galvanized Wire

OF VARIOUS GRADES FOR

TELEGRAPH AND TELEPHONE LINES.

WORKS AND OFFICE AT

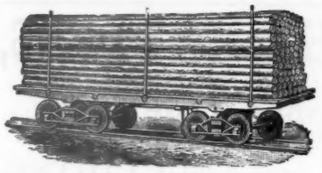
TRENTON, NEW JERSEY.

NEW YORK OFFICE:

COOPER, HEWITT & CO., 17 Burling Slip.

PHILADELPHIA OFFICE:

21 NORTH FOURTH STREET.



BROWNLEE & CO.

DETROIT, MICH.

DEALERS IN

Cedar Telegraph Poles,

MANUFACTURERS OF

Cross Arms, Pins and Brackets,

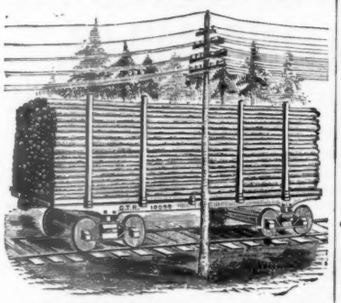
OAK and LOCUST PINS.

SEND FOR PRICE LIST.

☞ We defy competition in price or quality. ☜

Please mention this paper.

HANDSOME **POLES** & DURABLE.



CANADIAN CEDAR POLES, the best in use; live 25 to 35 years; good appearance. Prompt delivery at Buffalo, Black Rock or Suspension Bridge, N.Y. Cheap for spot Cash. Address

HARVEY STAFFORD & CO.,

ACTON, Ont., Canada.

ROYCE & MAREAN,

DEALERS IN

ELECTRICAL APPARATUS,

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel, **WASHINGTON, D. C.**

Correspondence Solicited.

National Electric Company,

ELECTRICAL SUPPLIES

AND APPARATUS,

1413 G STREET, WASHINGTON, D. C.

Estimates furnished. Correspondence solicited.

W. R. POPE & CO.

Corner North & Lexington Streets,

BALTIMORE, MD.

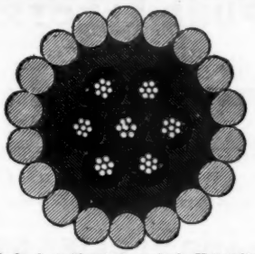
Telegraph, Telephone and Electric Light Supplies.

THE BEST OF EVERYTHING

AND AT LOWEST PRICES

The Bishop Gutta-Percha WORKS.

SAMUEL BOARDMAN, Agent.)



Original and only Manufacturers in the United States.

GUTTA-PERCHA INSULATED

Submarine Telegraph Cables,

50 Regular Sizes. One to Ten Conductors.

Subterranean Telegraph Cables,

Hempen-Armored Covered.

Aerial Telegraph Cables,

Lead or Hempen Covered.

ANTI-INDUCTION

Telephone (Lead-Covered) Cables,

as used by the Metropolitan Telephone & Telegraph Co.

Torpedo Cables,

Recommended by the European and South American Governments.

Lead-Covered Cables,

For Canal and Streamlet Crossings.

Gutta-Percha Office Wire, Leading and Connecting Wire,

For Subaqueous Mining and all other Electrical purposes.

Mark s Compound Insulated Wire,

For Office, Outdoor, Underground, and Battery Use.

G. P. Office Wire, Cotton-Covered.

ALSO HAVE ALWAYS ON HAND:

Wires of every variety of Insulation.

Magnet Wire, Telephone Flexible Cords, Flexible Elevator Cables, Electric Cordage, Burglar-Alarm and Annunciator Wire, Electric Light Wire, Cordage and Cables, Lead-Covered Wire, and every description of pure Gutta-Percha goods, Gutta-Percha Sheet, for Cable Splices; G. P. Chemical Vessels for Acids, etc.

Agents for Reception of Orders and Sale of Goods:

L. G. TILLOTSON & CO., 5 & 7 Dey St., New York.

WILLIAM HEATON, 503 Chestnut St., Phila.

Thirty-three years' experience has taught us that neither the electrical nor mechanical qualities of either Gutta-Percha or Copper deteriorate by long working or submersion, consequently the best form of a Submarine Telegraph cable will be that in which these conditions were fulfilled.—*Extract from Report on Cables, by Willoughby Smith.*

MANUFACTURED BY

The Bishop Gutta-Percha Works.

Address all communications to

W. W. MARKS, Superintendent,

420, 422, 424 & 426 East 25th St., N. Y.

OFFICE AT THE WORKS.

Rhode Island Telephone and Electric Co.

PROVIDENCE, R. I.,

MANUFACTURERS OF THE

Providence Telephone Switch-Boards,

BRECKENRIDGE JACKS,

Wright Cable Clips,

Howard Safety Appliance,

For protection to telephone subscribers against Lightning or Electric Light currents.

Dealers in Electric Appliances of every description.

Manufacturers and constructors of Lightning Rods upon scientific principles.

Licensees of The Time Telegraph Co. of New York for the New England States. Energetic men with capital wanted to form local plants in territory not yet disposed of.

Correspondence solicited from inventors, or parties having electrical novelties, with a view either to purchase or introduction as agents.

HENRY HOWARD, President.
C. T. HOWARD, Treasurer.
J. W. DUXBURY, Sec'y and Gen. Manager.
F. H. GARDINER, Assistant Manager.

S. W. FRENCH, President. **W. C. DEWEY, Treasurer.** **FRANK F. BULLARD, Gen'l Manager.**

PALMER WIRE COMPANY

PALMER, MASSACHUSETTS.

Galvanized **IRON** AND **STEEL,** AND

HARD-DRAWN COPPER Telegraph AND Telephone Wire.

UNSURPASSED IN

QUALITY of MATERIAL, FINISH and CONDUCTIVITY.

THE GALVANIZED IRON AND STEEL WIRE MANUFACTURED BY THIS COMPANY HAS ACHIEVED FOR ITSELF AN ENVIABLE REPUTATION FOR EXCELLENCE AMONG TELEPHONE AND TELEGRAPH COMPANIES WHO ARE USING IT EXTENSIVELY, AND BY WHOM IT IS UNIVERSALLY APPROVED. WE ARE NOW PREPARED TO SUPPLY **HARD-DRAWN COPPER WIRE** MADE FROM THE BEST LAKE SUPERIOR COPPER WITHOUT ALLOY BY A PROCESS LATELY DISCOVERED WHICH WE CONTROL. THIS WIRE IS THE EQUAL, IF NOT THE SUPERIOR OF ANYTHING IN THE MARKET. ORDERS, PROMPTLY AND CAREFULLY ATTENDED TO. SEND FOR QUOTATIONS.

NEW YORK OFFICE, - 15 COURTLANDT ST.

FRANK B. KNIGHT, GENERAL AGENT.

THE

United States Electric Lighting Co.

SOLE MANUFACTURERS OF

WESTON DYNAMO-ELECTRIC MACHINES

For both Arc and Incandescent Lighting.

WESTON ARC LAMPS, AUTOMATIC REGULATORS, FIXTURES, CARBONS, &c.

MAXIM INCANDESCENT LAMP.

And all Apparatus necessary for the most COMPLETE, EFFICIENT and RELIABLE SYSTEMS of Electric Arc and Incandescent Lighting.

OFFICE: 59 & 61 LIBERTY ST., NEW YORK.

George W. Hebard, *Pres.* Leonard E. Curtis, *Sec.* Ph. Ferd. Kobbé, *Treas.*

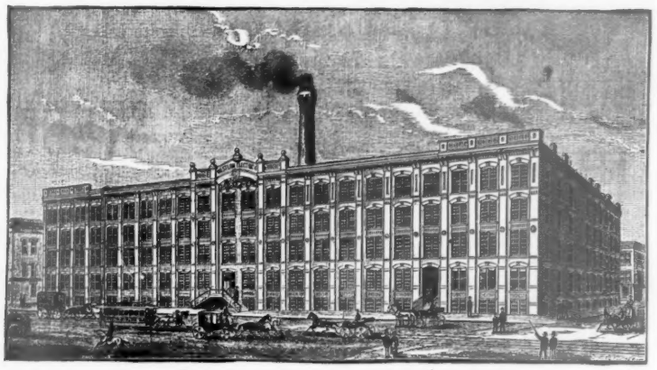
TRUSTEES:

Marcellus Hartley, Walter T. Hatch, Robert B. Minturn, Thomas H. Hubbard, Edward Weston, John A. Stewart, Louis Fitzgerald, Henry B. Hyde, Charles R. Flint, George W. Hebard, Anson Phelps Stokes, Henry Day, Leonard E. Curtis,

☞ SEND FOR CATALOGUE. ☜

Perfect Automatic Regulation in both Systems.

Western Electric Company.



(Chicago Factory, 227 to 251 South Clinton Street.)

MANUFACTURERS OF

TELEGRAPH and TELEPHONE APPARATUS

AND SUPPLIES OF EVERY DESCRIPTION.

Hotel and House Annunciators, Burglar Alarms and Call Bells,
Electro-Mercurial Fire Alarm, Electric Gas-Lighting Apparatus,
Magneto Call Bells, Telephone Exchange Switch Boards, etc.

UNDERGROUND AND AERIAL CABLES.

Correspondence Solicited.

CHICAGO, BOSTON, NEW YORK.

A. G. DAY

MANUFACTURER OF
KERITE INSULATED TELEGRAPH & TELEPHONE

WIRE & CABLES,

OFFICE, 120 BROADWAY, N. Y.—FACTORY, SEYMOUR, CONN.

Anti-Induction Kerite Telephone Cables.

Some of them Two Miles in Length, are in use in several cities, and are found to WORK PERFECTLY for that distance. EMINENT ELECTRICIANS and PRACTICAL TELEGRAPHISTS commend and recognize the Kerite Insulation as superior to all others. At the Centennial Exhibition at Philadelphia, Sir William Thomson, the eminent Electrician and Scientist, awarded to the KERITE INSULATED WIRE AND CABLES

A DIPLOMA

FOR "EXCELLENCE OF THE INSULATION AND DURABILITY OF THE INSULATOR."

GENERAL AGENT:

CLARK B. HOTCHKISS,—120 BROADWAY, NEW YORK.

THE BAXTER ELECTRIC LIGHT CO.

Is prepared to negotiate for New Plants, Complete.

THE BAXTER
IMPROVEMENT IN

ELECTRIC LAMPS

IS THE

Greatest Invention in Arc Lighting yet made.

Efficient, Reliable and More Economical than any other Lamp in the World, and can be applied to any System. SAVES FROM ONE-HALF TO THREE-QUARTERS THE COST OF CARBONS.

For terms for territory and cost of Baxter attachment, address:

THE BAXTER ELECTRIC LIGHT COMPANY,
MILLS BUILDING,
NEW YORK.

The Keystone Electric Co. of Philadelphia, Agents for Pennsylvania.

THE ANSONIA BRASS & COPPER CO.,

MANUFACTURERS OF

PURE ELECTRIC COPPER WIRE,

For Magnets, Telephones, Electric Light, &c.,
Patented Fire-Proof Electric Light Line Wire,
PATENTED FIRE & WEATHER PROOF ELECTRIC LIGHT LINE WIRE,
Patented Paragon Line Wire—Fire Proof, Water Proof,
"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE,
Wrought Metal Gongs for Annunciators,
Telephones, &c., Zinc Rods, Battery Copper, &c.,

WAREROOMS:

19 AND 21 CLIFF STREET, NEW YORK CITY.

Factories, Ansonia, Conn.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

HARD DRAWN COPPER LINE WIRE

FOR TELEGRAPH and TELEPHONE.

ELECTRIC LIGHT WIRE,

Magnet Wire, Patent "K K" Copper and Iron Wire,
Red and White Iron Line Wire.

NEW YORK, BOSTON AND PHILADELPHIA.

FACTORIES, WATERBURY, CONN.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

AUTOMATIC
QUICK ACTING ENGINE.

SELLING AGENTS:

JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
J. F. RANDALL, Warren, Ohio.
JOHN R. MARKLE, Detroit, Mich.
H. B. SMITH MACHINE CO., 925 Market St., Phil. Pa.
T. W. ANDERSON, Houston, Texas.
MIJNSSEN & CO., Amsterdam, Holland.

M. F. MOORE, Gen. Agt.
15 CORTLANDT ST., NEW YORK.

THE ELECTRICAL SUPPLY CO.
MANUFACTURERS OF

Insulated Wire

OF EVERY DESCRIPTION.

(Factory of the Electrical Supply Co. at Assonia, Ct.)

ELECTRIC LIGHT,
TELEPHONE, AND
TELEGRAPH SUPPLIES.

Warehouse: 17 DEY ST., NEW YORK.

ALFRED F. MOORE,

MANUFACTURER OF

Insulated Wire,

—FOR—

Telephone, Telegraph and Electric Light,
OFFICE, LINE,
—AND—
ANNUNCIATOR WIRE,
Magnet Wire and Flexible Cordage,

200 & 202 N. THIRD ST.,
PHILADELPHIA, PA.